Catalog of FEMA Building Science Branch

Publications and Training Courses

FEMA P-787 / Fourth Edition / March 2015

FEMA

Catalog of FEMA Building Science Branch

Publications and Training Courses

FEMA P-787 / Fourth Edition / March 2015

These publications, courses, and workshops have been developed by the Building Science Branch of the Federal Emergency Management Agency's (FEMA's) Federal Insurance and Mitigation Administration (FIMA).

Please visit http://www.fema.gov/resource-document-library to view or download publications.

ORDERING INFORMATION

To order publications from this catalog, please call 1-800-480-2520 or fax 240-699-0525 (Monday – Friday 8:00 a.m. – 5:00 p.m., EST) or send an email to FEMA-Publications-Warehouse@fema.dhs.gov. Please provide the title, item number, and quantity of each publication, along with your name, address, zip code, and daytime telephone number.

CONTENTS

ABOUT THIS CATALOG

FEMA's Building Science Branch has compiled this catalog of available FEMA publications, training courses, and workshops for natural hazards. The publication descriptions are first organized by primary hazard (earthquake, flood, high wind, multi-hazard, and other), and then by stakeholder groups: individuals and homeowners, teachers and kids, private sector and small business, community planning and policy, building professionals and engineers (contractors, builders, engineers, and architects), and Mitigation Assessment Team (MAT) reports, which are applicable to all stakeholders. Listings are further arranged by subject areas and in order of publication date (the most recent first) in the text. These materials are also listed by FEMA publication number in Table 1 starting on page 105. Each listing includes a set of icons that indicates the applicable hazards and whether the resource is available online, on CD, and/or in print.

See the inside cover of this document for ordering information.

The *Catalog of FEMA Earthquake Resources*, FEMA P-736B is also available and provides an overview of publications pertaining to earthquakes. It is available online at http://www.fema.gov/media-library/assets/documents/15092.

FEMA BUILDING SCIENCE BRANCH

The FEMA Building Science Branch leads FEMA's efforts to provide communities across the United States with technical guidance to reduce loss of life and property damage from earthquakes, floods, hurricanes, tornadoes, and other natural hazards. The Branch resides in the Risk Reduction Division of FEMA's Federal Insurance Mitigation Administration (FIMA) and is staffed by highly skilled national experts on building codes, disaster-resistant construction techniques, and post-disaster rebuilding strategies. Building Science Branch activities include deploying MATs to conduct post-disaster engineering investigations for both man-made and natural hazard events. Building Science takes a lead role in developing publications, guidance materials, tools, technical bulletins, and recovery advisories that incorporate the most up-to-date building codes, seismic design standards, floodproofing requirements, and wind design requirements for new construction and the repair and retrofitting of existing buildings. In addition to providing technical support for the development and adoption of model building codes and standards, the Building Science Branch provides technical support for the the National Earthquake Hazards Reduction Program (NEHRP), the National Flood Insurance Program (NFIP) for public and private sector stakeholders, and the National Windstorm Impact Reduction Program (NWIRP), and pursues outreach strategies for communicating Building Science issues.

Visit us at: https://www.fema.gov/building-science.

For more information about FEMA Building Science publications, please contact the FEMA Building Science Helpline by email at FEMA-BuildingScienceHelp@fema.dhs.gov or by phone at (866) 927-2104 (toll free).

To subscribe to FEMA Building Science e-mail updates, visit https://service.govdelivery.com/accounts/USDHSFEMA/subscriber/new?topic_id=USDHSFEMA_193.

EARTHQUAKE PUBLICATIONS

INDIVIDUALS & HOMEOWNERS

Protecting Property

FEMA B-526 – *Earthquake Safety Checklist* (December 2014)

This quick-reference guide helps individuals and families prepare for an earthquake and prevent earthquake-related damage to their homes. The easy-to-read brochure features instructions on conducting earthquake drills and "hazard hunts." Also included are a checklist of disaster supplies, tips on what to do during and after an earthquake, and additional resources. Available in English and Spanish in print and multiple languages online.

https://www.fema.gov/media-library/assets/documents/3234

FEMA V-528 – *Earthquake Home Hazard Hunt Poster* (September 2014)

This poster provides visuals and descriptions so that homeowners can identify and fix at- risk areas of their homes to reduce future earthquake damage and disruption.

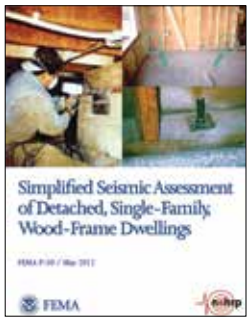
https://www.fema.gov/media-library/assets/documents/3261

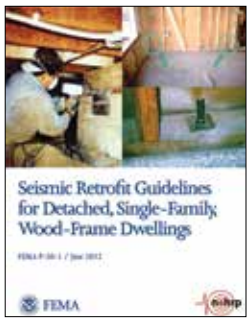
FEMA E-74CD – *Reducing the Risks of Nonstructural Earthquake Damage: A Practical Guide* (Fourth Edition, December 2012)

This fourth edition of FEMA 74 has been redesigned for use online and expanded to include more examples that feature photos of actual damage and details illustrating correct mitigation measures. The online format makes it easy to browse and print out relevant details. The guide describes the sources of nonstructural earthquake damage and effective methods of reducing potential risks associated with such damage. It assists in identifying potential hazards and provides specific guidance on upgrades. The guide also contains a glossary, references, and an annotated bibliography for those who desire additional information. A nonstructural inventory form, a checklist of nonstructural earthquake hazards, and an explanation of nonstructural risk ratings are included as appendices. Target audiences for the guide include build-

ing owners, facility managers, maintenance personnel, homeowners, store or office managers, business proprietors, organizational department heads, and others concerned with building safety and the continuation of business.

https://www.fema.gov/media-library/assets/documents/21405?id=4626





FEMA P-50 and FEMA P-50-1 – *Simplified Seismic Assessment of Detached, Single-Family, Wood-Frame Dwellings and Seismic Retrofit Guidelines for Detached, Single-Family, Wood-Frame Dwellings* (May-June 2012)

FEMA P-50 explains how to use the Simplified Seismic Assessment Form to calculate a Seismic Performance Grade for a detached, single-family, wood-frame home. The grade is based on a Structural Score and Seismic Hazard Score, which are derived using location- specific data available through online websites. The companion publication FEMA P-50-1 describes low-cost seismic retrofitting techniques that can be used to address deficiencies identified on the Simplified Seismic Assessment Form, and shows how implementing those techniques could improve a home's grade. These publications provide a tool that communities or others can use to encourage the seismic retrofitting of residential structures to reduce future earthquake losses.

https://www.atcouncil.org/images/files/FEMA_P-50.pdf

https://www.atcouncil.org/images/files/FEMA_P-50-1.pdf

FEMA P-711CD – *Earthquake Publications for Individuals and Homeowners* (June 2008)

This compilation contains all of the publications listed in this section (Individuals and Home owners) of the catalog. Two additional publications are also included: "Drop, Cover, and Hold Poster" (FEMA V-529); and "The Adventures of Terry the Turtle and Gracie the Wonder Dog, Grades 3–6" (FEMA 531).

FEMA 232 and P-232CD – *Homebuilders' Guide to Earthquake Resistant Design and Construction* (June 2006)

This illustrated guide presents seismic design and construction guidance for one- and two- family light frame residential structures that can be utilized by homebuilders, knowledgeable homeowners, and other non-engineers, and provides information supplemental to the 2003 edition of the "International Residential Code." The guide presents background information on the principles of seismic resistance and how earthquake forces impact conventional residential construction and more detailed information on architectural considerations (site selection, foundations and foundation details, floors, shear walls, and roofs). Also included are discussions of masonry and stone elements,

examples of typical floor plans for earthquake- resistant one- and two-story homes, excerpts of seismic requirements from building codes, and checklists for homebuilders. The guide also presents a series of "above-code recommendations" that provide low-cost measures to increase the performance of the building and help keep it functional after an earthquake. The CD–ROM, FEMA P-232CD, contains both English- and Spanish-language versions of the FEMA 232 publication, as well as related training materials.

https://www.fema.gov/media-library/assets/documents/6015

FEMA 530 – *Earthquake Safety Guide for Homeowners* (September 2005)

This updated safety guide, which was originally developed and published by the California Seismic Safety Commission, provides homeowners with a good start to strengthening their homes against earthquake damage. The guide also illustrates the relative cost of prevention versus repair or replacement.

https://www.fema.gov/media-library/assets/documents/1017

Emergency Preparedness

FEMA B-526 – *Earthquake Safety Checklist* (December 2014)

This quick-reference guide helps individuals and families prepare for an earthquake and prevent earthquake-related damage to their homes. The easy-to-read brochure features instructions on conducting earthquake drills and "hazard hunts." Also included are a checklist of disaster supplies, tips on what to do during and after an earthquake, and additional resources. Available in English and Spanish in print and multiple languages online.

https://www.fema.gov/media-library/assets/documents/3234

TEACHERS & KIDS

Curricula & Activities

FEMA P-710CD – *Earthquake Publications for Teachers and Kids* (June 2008)

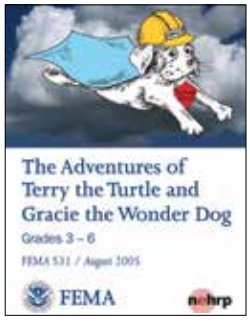
This compilation contains all of the publications listed in this section (Teachers and Kids) of the catalog. Two additional publications are also included: "Earthquake Safety Checklist" (FEMA B-526), and "Earthquake Home Hazard Hunt Poster" (FEMA 528).

https://www.fema.gov/media-library/assets/documents/16661

FEMA 527 – *Earthquake Safety Activities for Children and Teachers* (August 2005)

This publication provides elementary-school teachers with ready-to-use, hands-on activities that explain what happens during an earthquake, how to prepare for earthquake shaking, and how to stay safe during and after an earthquake. Included are a variety of handouts for students, including maps, songs, "hazard hunt" worksheets, and earthquake safe ty checklists.

http://www.fema.gov/media-library-data/20130726-1508-20490-6311/fema-527.pdf



FEMA 531 – *The Adventures of Terry the Turtle and Gracie the Wonder Dog, Grades 3–6* (August 2005)

This storybook for children in grades 3–6 relates the adventures of the safety-conscious mayor of Shakeyville (Terry the Turtle) and a team of safety volunteers who meet with students at the local elementary school to teach them about earthquake safety. The students discover the importance of earthquake safety and preparedness. Included are suggestions for creating a disaster kit, illustrations of what to do if an earthquake happens (Drop, Cover, and Hold), and a list of resources.

https://www.fema.gov/media-library/assets/documents/3279

FEMA 159 and FEMA 159CD–*Tremor Troop: Earthquakes—A Teacher's Package for K–6* (July 2002)

This teacher's package for grades K–6 provides ready-to-use, hands-on activities for students and teachers on the science of earthquakes and earthquake safety. This edition contains assessments throughout the units, matrices linking activities to the National Science Education Standards, and a new glossary. Four of the five units are divided into levels by grades: Level 1, for grades K–2; Level 2, for grades 3–4; and Level 3, for grades 5–6. The lessons introduce how earthquakes are defined, why and where earthquakes occur, the physical results of earthquakes, and how earthquakes are measured. The final unit addresses earthquake safety and survival and includes activities for students in all grades K–6. At the end of each unit, ready- to-reproduce masters are provided for classroom use.

https://www.fema.gov/media-library/assets/documents/2915

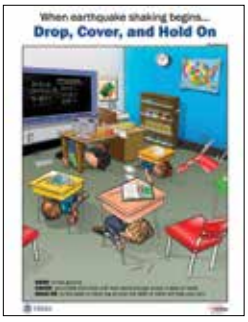
FEMA 253 – *Seismic Sleuths: A Teacher's Package for Grades 7–12* (October 1995)

This package provides middle-school and high-school teachers with information about the causes and effects of earthquakes. Activity sheets for students and background materials for teachers are provided in each of the volume's six units. The units assess students' knowledge of earthquakes; provide information on preparedness and emergency management; discuss the causes of earthquakes and their effects; present information on seismic waves and the development of seismology and instruments used to measure an earthquake's magnitude; explain the effects of earthquakes on buildings and earthquake-resistant design techniques; and discuss earthquake preparedness and the reactions of different populations to historical earthquakes. The last unit provides a variety of summary and assessment activities and a list of additional resources. The CD–ROM, FEMA 253CD, Second Edition, 2005, contains curriculum supplements that provide middle-school and high-school teachers with background materials and activity sheets for students.

https://www.fema.gov/media-library/assets/documents/15229

Emergency Preparedness

FEMA 529 – *Drop, Cover, and Hold Poster* (September 2014)



This poster is intended for classroom use. It depicts a teacher and students in a classroom responding appropriately to the first sign of an earthquake (Drop, Cover, and Hold). Available in English and Spanish in print, and multiple languages online.

https://www.fema.gov/media-library/assets/documents/3266

FEMA 527 – *Earthquake Safety Activities for Children and Teachers* (August 2005)

This publication provides elementary-school teachers with ready-to-use, hands-on activities that explain what happens during an earthquake, how to prepare for earthquake shaking, and how to stay safe during and after an earthquake. Included are a variety of handouts for students, including maps, songs, "hazard hunt" worksheets, and earthquake safe ty checklists.

http://www.fema.gov/media-library-data/20130726-1508-20490-6311/fema-527.pdf

PRIVATE SECTOR & SMALL BUSINESS

FEMA P-909CD – *Home and Business Earthquake Safety and Mitigation* (June 2014)

This new training program on structural and nonstructural earthquake mitigation has three components: a *Train-the-Trainer* course, a *Home and Business Earthquake Safety and Mitigation* course, and a *Hands-On Interactive Mitigation Demonstration*. The goal of the training is to create a cadre of trainers with the ability to provide basic knowledge on earthquakes and the simple steps that should be taken for earthquake mitigation in homes and businesses. On successful completion of the Train-the-Trainer course offered through the FEMA National Earthquake Technical Assistance Program (NETAP), students will be certified to train others. The P-909CD consists of PowerPoint slides, hands-on demonstration instructions, supply lists, scripts, a quiz and answers, certificates, and posters. Audiences include government at all levels, emergency managers, first responders, businesses, volunteer community groups, and all others interested in leading an earthquake safety presentation.

https://www.fema.gov/media-library/assets/documents/97275

FEMA E-74CD – *Reducing the Risks of Nonstructural Earthquake Damage: A Practical Guide* (Fourth Edition, December 2012)

This fourth edition of FEMA 74 has been redesigned for use online and expanded to include more examples that feature photos of actual damage and details illustrating correct mitigation measures. The online format makes it easy to browse and print out relevant details. The guide describes the sources of nonstructural earthquake damage and effective methods of reducing potential risks associated with such damage. It assists in identifying potential hazards and provides specific guidance on upgrades. The guide also contains a glossary, references, and an annotated bibliography for those who desire additional information. A nonstructural inventory form, a checklist of nonstructural earthquake hazards, and an explanation of nonstructural risk ratings are included as appendices. Target audiences for the guide include building owners, facility managers, maintenance personnel, homeowners, store or office managers, business proprietors, organizational department heads, and others concerned with building safety and the continuation of business.

https://www.fema.gov/media-library/assets/documents/21405

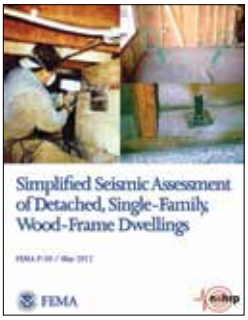
FEMA P-811 DVD – *Earthquake Publications for Businesses (QuakeSmart Toolkit)* (September 2011)

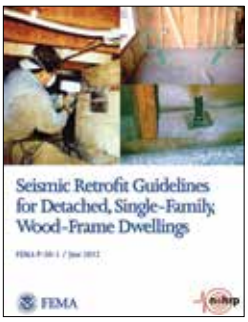
Developed by FEMA for NEHRP, QuakeSmart is an initiative to help businesses in seismically at-risk communities start and maintain earthquake mitigation efforts. The QuakeSmart Toolkit provides actionable and scalable basic guidance and tools to the private sector about the importance of earthquake mitigation and the simple things that businesses can do to reduce the potential for earthquake damages, injuries, and financial losses. The toolkit walks you through a three-step process: 1) identify your risk, 2) make a plan, and 3) take action. This information was specifically developed to encourage businesses to incorporate earthquake mitigation into their decision making and planning processes to enhance their all-hazards resilience.

https://www.fema.gov/media-library/assets/documents/23902

COMMUNITY PLANNING & POLICY

FEMA P-50 and FEMA P-50-1 – *Simplified Seismic Assessment of Detached, Single-Family, Wood-Frame Dwellings and Seismic Retrofit Guidelines for Detached, Single-Family, Wood-Frame Dwellings* (May-June 2012)





FEMA P-50 explains how to use the Simplified Seismic Assessment Form to calculate a Seismic Performance Grade for a detached, single-family, wood-frame home. The grade is based on a Structural Score and Seismic Hazard Score, which are derived using location- specific data available through online websites. The companion publication FEMA P-50-1 describes low-cost seismic retrofitting techniques that can be used to address deficiencies identified on the Simplified Seismic Assessment Form, and shows how implementing those techniques could improve a home's grade. These publications provide a tool that communities or other entities can use to encourage the seismic retrofitting of residential structures to reduce future earthquake losses.

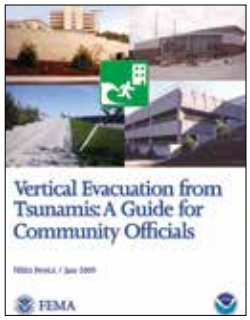
https://www.atcouncil.org/images/files/FEMA_P-50.pdf

https://www.atcouncil.org/images/files/FEMA_P-50-1.pdf

FEMA P-749 – *Earthquake-Resistant Design Concepts: An Introduction to the NEHRP Recommended Seismic Provisions* (December 2010)

This document provides a readily understandable explanation of the intent and requirements of seismic design in general and the "NEHRP Recommended Seismic Provisions for New Buildings and Other Structures" (FEMA P-750) in particular. FEMA P-750 and the building codes and standards based on its recommendations are technical documents intended primarily for use by design and construction professionals. However, understanding the basis for the seismic regulations contained in the Nation's building codes and standards is important to many people outside this technical community. This publication is designed for elected officials, members of the insurance and financial communities, business owners, and other interested individuals.

https://www.fema.gov/media-library/assets/documents/21866



FEMA P-646A – *Vertical Evacuation from Tsunamis: A Guide for Community Officials* (June 2010)

This document provides guidance for local officials on how to implement the design guidelines detailed in "Guidelines for Design of Structures for Vertical Evacuation from Tsunamis" (FEMA P-646). It examines how communities can plan, fund, construct, operate, and maintain vertical evacuation refuges.

https://www.fema.gov/media-library/assets/documents/17050

FEMA P-774 and P-774CD – *Unreinforced Masonry Buildings and Earthquakes: Developing Successful Risk Reduction Programs* (October 2009)

This publication provides guidance on reducing the risks from URM buildings in seismically active areas. URM buildings are typically the most vulnerable to earthquake damage and the type of construction that is most commonly singled out for voluntary and mandatory seismic risk reduction programs. The document includes illustrations and photographs of URM buildings and describes their seismic vulnerabilities. It discusses policy and regulatory issues that often must be considered, such as retrofit costs, the economic viability of older buildings, numbers of occupants and types of use, and historic or architectural values. Rather than prescribing a rigid sequence of steps for URM risk reduction, FEMA P-774 documents a wide variety of successful approaches that have been developed across the U .S.

https://www.fema.gov/media-library/assets/documents/18030

FEMA P-712CD – *Earthquake Publications for Community Planners and Public Policy Makers* (June 2008)

This compilation contains most of the publications that provide information and guidance for local planners, policy makers, and advocates interested in assessing and responding to seismic hazards and the risks they pose for their communities.

https://www.fema.gov/media-library/assets/documents/15201

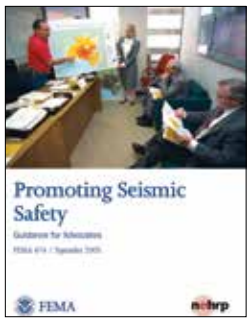
FEMA 366 – *HAZUS*® MH *Estimated Annualized Earthquake Losses for the United States* (April 2008)

Recent earthquakes around the world show a pattern of steadily increasing damages and losses that is due primarily to two factors: (1) significant growth in earthquake-prone urban areas, and (2) vulnerability of the older building stock, including some buildings constructed within the past 20 years. This publication highlights the impacts of both high risk and high ex-

posure on losses caused by earthquakes. It is based on loss estimates generated by Hazus–MH, an electronic loss estimation tool that provides a method for quantifying future earthquake losses. FEMA's objective in producing this report was to assess levels of seismic risk in the United States using Hazus–MH and nationwide data. The analysis computes two interrelated metrics to characterize earthquake risk: Annualized Earthquake Loss and the Annualized Earthquake Loss Ratio.

https://www.fema.gov/media-library/assets/documents/13293

FEMA 474 – *Promoting Seismic Safety: Guidance for Advocates* (September 2005)



This booklet offers advice to assist seismic safety advocates in presenting risk-reduction information and ideas. The full version of "Promoting Seismic Safety: Guidance for Advocates" is a 200-plus page report that consists of two parts. Part One is the guidance provided in this booklet. Part Two is a set of background papers developed by the authors as part of the project.

https://www.fema.gov/media-library/assets/documents/3229

FEMA 275 – *Planning for Seismic Rehabilitation: Societal Issues* (March 1998)

This publication provides users with an understanding of the social and public policy issues that may accompany seismic rehabilitation, such as demographic, social, and economic impacts; historic property restrictions; resident dislocations; and business interruptions. The publication presents a four-step decision process to assist local officials, private owners, and design professionals in determining the need for rehabilitation. It includes an "escalation lad der" to assist in understanding the degree of conflict that might be generated and the implica tions of choosing particular strategies.

https://www.fema.gov/media-library/assets/documents/1928

FEMA 313 – *Promoting the Adoption and Enforcement of Seismic Building Codes: A Guidebook for State Earthquake and Mitigation Managers* (January 1998)

This guidebook provides background information and educational materials to help state officials promote the adoption, administration, and enforcement of state and local model building codes that contain the latest seismic provisions. The guidebook describes the purpose, function, and effectiveness of building codes in general and seismic codes in particular and presents a step-by-step process for adopting and administering state or local codes. The appendices include the history and principles of seismic design; a state-by-

state listing of state codes and code influences; seismic design practices in the United States; examples of state and local building codes and state legislation; the services of model code organizations in the United States; and resources, recommended readings, and educational materials.

https://www.fema.gov/media-library/assets/documents/564

FEMA 83 – *Seismic Considerations for Communities at Risk* (September 1995)

This publication provides individuals and community decision-makers with information they can use to assess seismic risk, make informed decisions about seismic safety in their communities, and determine what can be done to mitigate risk. The publication includes information on the scope of earthquake risk in the United States, the effects of earthquakes on buildings, how design can reduce earthquake effects, and the importance of seismic codes and the "NEHRP Recommended Seismic Provisions for New Buildings and Other Structures" (FEMA P-750). Also included are factors to consider when deciding whether and how to take action to reduce earthquake risk and suggestions for stimulating community action.

https://www.fema.gov/media-library/assets/documents/2523

FEMA 266 – *Creating a Seismic Safety Advisory Board: A Guide to Earthquake RiskManagement* (August 1995)

This guide assists states, state coalitions, and local governments in creating, developing, and nurturing seismic safety advisory boards. It provides information on board operations, including staffing and funding a board, and guidelines for strategic planning and developing a mod el seismic risk management program to measure progress. The appendices include model executive orders, enabling legislation, staff duty descriptions, workshop designs, and workshop rosters; examples of an interstate compact, articles of incorporation, and corporate by-laws; a list of existing seismic safety advisory boards; and a lexicon of terms.

https://www.fema.gov/media-library/assets/documents/3032

FEMA 198 – *Financial Incentives for Seismic Rehabilitation of Hazardous Buildings—An Agenda for Action. Volume 1: Findings, Conclusions, and Recommendations*(September 1990)

The Financial Incentives series publications (Volumes 1–3, FEMA 198, FEMA 199, and FEMA 216) identify and describe the existing and potential regulatory and financial mechanisms and incentives for lessening the risks posed by existing buildings in an earthquake. Volume 1 includes a discussion of the methodology used in this series, background information on financial incen-

tives, and findings, conclusions, and recommendations for decision makers at the local, state, and national levels.

FEMA 199 – *Financial Incentives for Seismic Rehabilitation of Hazardous Buildings—An Agenda for Action. Volume 2: State and Local Case Studies and Recommendations* (September 1990)

The Financial Incentives series publications identify and describe the regulatory and financial mechanisms and incentives for lessening the risks posed by existing buildings. Volume 2 includes detailed descriptions of the 20 case studies that were examined as part of the project.

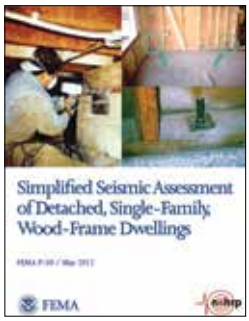
FEMA 182 – *Landslide Loss Reduction: A Guide for State and Local Government Planning* (August 1989)

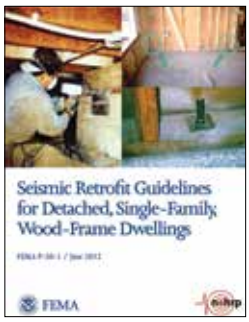
This guide provides information for state and local officials involved in landslide mitigation. It describes the benefits of landslide mitigation; the causes and types of landslides; hazard identification, assessment, and mapping; the transfer and use of information; loss-reduction techniques; plan preparation and review; and approaches to overcoming problems. Illustrations provide additional information on the causes of and damage resulting from landslides.

https://www.fema.gov/media-library/assets/documents/437

BUILDING PROFESSIONALS & ENGINEERS

Residential Buildings





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https://www.atcouncil.org/images/files/FEMA_P-50.pdf

https://www.atcouncil.org/images/files/FEMA_P-50-1.pdf

FEMA P-593CD – *Seismic Rehabilitation Training for One- and Two-Family Dwellings: Program and Slide Presentations* (January 2010)

This product contains PowerPoint slide presentations, an instructional guide, and speaker's notes for training contractors, code officials, and other parties interested in the seismic retrofitting of existing light-frame dwellings. It has been used by the International Code Council (ICC) as the basis for a series of webinars.

https://www.fema.gov/media-library/assets/documents/21023

FEMA 232 and P-232CD – *Homebuilders' Guide to Earthquake Resistant Design and Construction* (June 2006)

This illustrated guide presents seismic design and construction guidance for one- and two- family light frame residential structures that can be utilized by homebuilders, knowledgeable homeowners, and other non-engineers, and provides information supplemental to the 2003 edition of the "International Residential Code." The guide presents background information on the

principles of seismic resistance and how earthquake forces impact conventional residential construction and more detailed information on architectural considerations (site selection, foundations and foundation details, floors, shear walls, and roofs). Also included are discussions of masonry and stone elements, examples of typical floor plans for earthquake- resistant one- and two-story homes, excerpts of seismic requirements from building codes, and checklists for homebuilders. The guide also presents a series of "above-code recommendations" that provide low-cost measures that would increase the performance of the building and help keep it functional after an earthquake. FEMA P-232CD, contains both English and Spanish versions of the FEMA 232 publication, as well as related training materials.

https://www.fema.gov/media-library/assets/documents/6015

Existing Construction

FEMA P-1026 – *Seismic Design of Rigid Wall-Flexible Diaphragm Buildings: An Alternate Design Procedure* (Coming in 2015)

Warehouse or retail store buildings in the U.S. are commonly built as single-story "big-boxes." These buildings typically have stiff walls constructed of reinforced concrete or masonry, or braced frames of structural steel, and relatively flexible roofs of metal deck or wood structural panels. This type of structure is often referred to as Rigid-Wall and Flexible-Diaphragm (RWFD) buildings. The seismic response of these buildings is dominated by deflection of the diaphragm rather than the vertical seismic resisting system, as assumed by building code procedures. This publication presents an alternate design procedure to consider this characteristic response and improve seismic performance related to large diaphragm deflections. The procedure has yet to be vetted by a standards body for future adoption into building codes and standards. The principles and technical approach may be appropriate and useful in voluntary seismic strengthening projects.

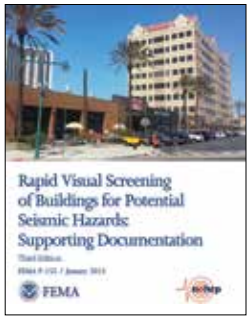
FEMA P-1024 – *Performance Assessment of Buildings and Nonstructural Components in the 2014 South Napa Earthquake* (Coming in 2015)

Data from a USGS strong-motion recording instrument located in downtown Napa was used to investigate every building within a 1,000 foot radius using the Applied Technology Council (ATC)-38 methodology to compare their performance to the known ground motion and document mitigation performance. This data was used to evaluate the performance of nonstructural components, responsible for the vast majority of the damage and injuries as well as help validate the new FEMA P-58 Seismic Performance Assessment of Buildings and FEMA P-154 Rapid Visual Screening methodologies. The project also focused on the performance of seismic retrofitting of URM buildings, which was required under State law.

FEMA P-154 and P-154CD – *Rapid Visual Screening of Buildings for Potential Seismic Hazards: A Handbook* (Third Edition, January 2015)

The FEMA P-154 Handbook describes how to identify the structural type and key weakness characteristics, how to complete the screening forms, and how to manage a successful RVS program. The new third edition of FEMA P-154 includes extensive updates, including improvements in the methodology, the screening forms, and the underlying scoring; the addition of a more detailed professional screening option (level 2 screening); new quick reference guides with extensive figures illustrating important building characteristics; an electronic scoring option; and guidance on how to administer an effective screening program. The FEMA P-154 CD contains PowerPoint slides with instructor notes; the RVS Student Manual (FEMA 154SM); data collection forms; and PDF- and text-file versions of FEMA P-154 (both FEMA P-154 and FEMA P-155 include the FEMA P-154 CD).

https://www.fema.gov/media-library/assets/documents/15212



FEMA P-155 – *Rapid Visual Screening of Buildings for Potential Seismic Hazards: Supporting Documentation* (Third Edition, January 2015)

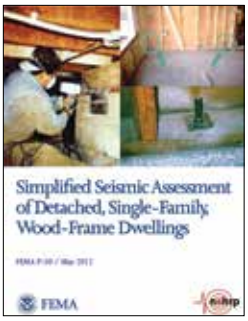
The third edition companion to FEMA P-154 describes the technical background and process used to update the Handbook and the revisions considered and conclusions reached. Extensive detail is also provided in FEMA P-155 on the third edition scoring and associated risk.

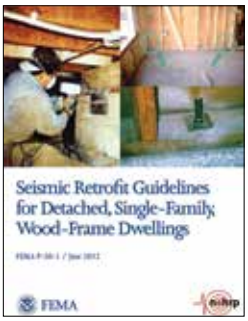
https://www.fema.gov/media-library/assets/documents/15212

FEMA P-154 ROVER CD, Version 2 – *Rapid Observation of Vulnerability and Estimation of Risk* (September 2014)

Rapid Observation of Vulnerability and Estimation of Risk (ROVER) is a mobile software for pre- and post-earthquake building safety screening. ROVER's pre-earthquake module is used by field inspectors to quickly compile an electronic inventory of buildings, record seismic features of a building, and generate an automatic estimate of the need for detailed seismic evaluation. ROVER's post-earthquake module is used to quickly perform and manage the red, yellow, and green safety tagging almost universally applied to buildings after earthquakes. The ROVER Version 2 software works on any device with a web browser and data connection and has a screen layout that automatically adapts to a smartphone, tablet, or PC.

FEMA P-50 and FEMA P-50-1 – *Simplified Seismic Assessment of Detached, Single-Family, Wood-Frame Dwellings and Seismic Retrofit Guidelines for Detached, Single- Family, Wood-Frame Dwellings* (May-June 2012)



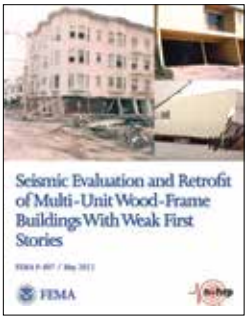


FEMA P-50 explains how to use the Simplified Seismic Assessment Form to calculate a Seismic Performance Grade for a detached, single-family, wood-frame home. The grade is based on a Structural Score and Seismic Hazard Score, which are derived using location- specific data available through online websites. The companion publication FEMA P-50-1 describes low-cost seismic retrofitting techniques that can be used to address deficiencies identified on the Simplified Seismic Assessment Form, and shows how implementing those techniques could improve a home's grade. These publications provide a tool that can be used to encourage seismic retrofitting of residential structures to reduce future earthquake losses.

https://www.atcouncil.org/images/files/FEMA_P-50.pdf

https://www.atcouncil.org/images/files/FEMA_P-50-1.pdf

FEMA P-807 – Seismic Evaluation and Retrofit of Multi-Unit Wood-Frame Buildings With Weak First Stories (May 2012)



Multi-unit, wood-frame buildings with weak first stories represent a significant risk in highly seismic regions of the United States because of their high potential for collapse. This collapse potential is due primarily to soft or weak first-story walls, which have often been weakened by large numbers of openings, such as for garages or storefront windows. This publication provides guidelines for the seismic retrofitting of weak-story, wood-frame buildings in seismically active regions, with a focus on multi-family, multi-story buildings with weak first stories, such as those damaged in the 1989 Loma Prieta earthquake, and on apartment buildings with tuck-under parking, such as those damaged in the 1994 Northridge earthquake. These are the first guidelines to focus solely on weak first stories and on incorporating just enough added strength to protect the first floor from collapse but not enough to drive earthquake forces into upper stories, placing them at risk of collapse. They are also the first guidelines to take into account the strength provided by existing nonstructural walls, which makes retrofitting more affordable. The print version of FEMA P-807 includes a CD containing a related spreadsheet tool.

https://www.fema.gov/media-library/assets/documents/32681

FEMA P-767CD – *Earthquake Mitigation for Hospitals* (May 2010)

This PowerPoint presentation is based on FEMA 396, Incremental Seismic Rehabilitation of Hospital Buildings: Providing Protection to People and Buildings. Recognizing that seismic mitigation can be expensive and disruptive, the purpose of this workshop is to introduce users to an innovative approach to seismic mitigation called "incremental seismic rehabilitation." The approach essentially identifies systematic opportunities to conduct mitigation activities. Students are introduced to earthquake hazards in health care settings and learn about methods that can be used to analyze and reduce risks of damage in hospitals and other medical buildings. By implementing sound, cost-effective mitigation measures, health care facilities can reduce or eliminate seismic risks and ensure that, in the event of an earthquake, they can remain in operation to serve their communities.

https://www.fema.gov/media-library/assets/documents/22391

FEMA P-593CD – *Seismic Rehabilitation Training for One- and Two-Family Dwellings: Program and Slide Presentations* (January 2010)

This product contains PowerPoint slide presentations, an instructional guide, and speaker's notes for training contractors, code officials, and other parties interested in the seismic retrofitting of existing light frame dwellings. It has been used by the International Code Council as the basis for a series of webinars that have been presented to its membership.

https://www.fema.gov/media-library/assets/documents/21023

FEMA P-774 and P-774CD – *Unreinforced Masonry Buildings and Earthquakes: Developing Successful Risk Reduction Programs* (October 2009)

This publication provides guidance on reducing the risks from URM buildings in seismically active areas. URM buildings are typically the most vulnerable to earthquake damage and the type of construction that is most commonly singled out for voluntary and mandatory seismic risk reduction programs. The document includes illustrations and photographs of URM buildings and describes their seismic vulnerabilities. It discusses policy and regulatory issues that often must be considered, such as retrofit costs, the economic viability of older buildings, numbers of occupants and types of use, and historic or architectural values. Rather than prescribing a rigid sequence of steps for URM risk reduction, FEMA P- 774 documents a wide variety of successful approaches that have been developed across the U.S.

https://www.fema.gov/media-library/assets/documents/18030

FEMA 547 and 547CD – *Techniques for the Seismic Rehabilitation of Existing Buildings* (2006 Edition, February 2007)

This publication documents common seismic rehabilitation or retrofitting techniques used for buildings represented in the set of standard building types presented in FEMA seismic publications. It includes a wide variety of techniques that have been developed and used for repair and retrofitting of earthquake-damaged and seismically deficient buildings.

https://www.fema.gov/media-library/assets/documents/8564

FEMA 395–400 and P-420 – *Incremental Seismic Rehabilitation Publications*

These publications present an innovative approach that involves implementing a series of discrete rehabilitation, or retrofitting, actions in phases over a period of several years. Incremental seismic rehabilitation is an effective, affordable, and non-disruptive mitigation strategy, and can be integrated into ongoing facility maintenance and capital-improvement operations to minimize costs and disruption. The publications address different occupancies, including schools, hospitals, apartment buildings, office buildings, and hotels, and target building owners, facility managers, financial and risk managers, and others who have a role in building safety and loss reduction. A companion manual targeted to engineers and design professionals (FEMA P-420) is also available.

- FEMA 395 – *Incremental Seismic Rehabilitation of School Buildings* (K–12) (June 2003)

  This manual provides school administrators and board members with the information they need to assess the seismic vulnerability of existing school buildings and to implement a program of incremental seismic rehabilitation.

  https://www.fema.gov/media-library/assets/documents/5154

- FEMA 396 – *Incremental Seismic Rehabilitation of Hospital Buildings* (December 2003)

  This manual provides health care administrators and board members with the information they need to assess the seismic vulnerability of hospitals and other existing health care facilities, and to implement a program of incremental seismic rehabilitation.

  https://www.fema.gov/media-library/assets/documents/5167

- FEMA 397 – *Incremental Seismic Rehabilitation of Office Buildings* (December 2003)

  Office buildings may be owned by partnerships, individuals, pension funds, real estate investment trusts, and other entities. This manual provides the information that these owners need to assess the seismic vulnerability of their buildings and to implement a pro- gram of incremental seismic rehabilitation.

  https://www.fema.gov/media-library/assets/documents/5182

- FEMA 398 – *Incremental Seismic Rehabilitation of Multifamily Apartment Buildings* (February 2004)

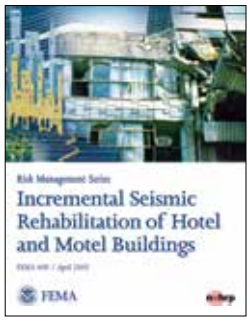
  This manual is designed for partnerships, individuals, pension funds, real estate investment trusts, and other entities who own Class A, B, or C multifamily buildings. It provides the information that these owners need to assess the seismic vulnerability of their buildings and to implement a program of incremental seismic rehabilitation.

  https://www.fema.gov/media-library/assets/documents/5199

- FEMA 399 – *Incremental Seismic Rehabilitation of Retail Buildings* (July 2004)

  This manual is targeted to partnerships, individuals, pension funds, real estate investment trusts, and other entities who own Class A, B, or C retail buildings. It provides the information that these owners need to assess the seismic vulnerability of their buildings and to implement a program of incremental seismic rehabilitation.

  https://www.fema.gov/media-library/assets/documents/5216



- FEMA 400 – *Incremental Seismic Rehabilitation of Hotel/ Motel Buildings* (April 2005)

  This manual provides the owners of hotels and motels with the information they need to assess the seismic vulnerability of their buildings and to implement a program of incremental seismic rehabilitation.

  https://www.fema.gov/media-library/assets/documents/826

- FEMA P-420 – *Engineering Guideline for Incremental Seismic Rehabilitation* (May 2009)

  This publication provides guidance for engineers and architects on implementing programs of incremental seismic rehabilitation for building owners. It reviews all FEMA publications that contain information on seismic evaluation and rehabilitation of existing buildings, and provides guidance on how to apply that information to incremental seismic rehabilitation programs.

  https://www.fema.gov/media-library/assets/documents/16947

FEMA 356 – *Prestandard and Commentary for the Seismic Rehabilitation of Buildings* (November 2000)

This prestandard serves as a nationally applicable tool for design professionals, code officials, and building owners undertaking the seismic rehabilitation, or retrofitting, of existing buildings. Chapters address requirements; analytical procedures; foundations and geologic site hazards; steel; concrete; masonry; wood and light-metal framing; seismic isolation and energy dissipation; simplified rehabilitation; architectural, mechanical, and electrical components; and use of the prestandard for risk mitigation programs. This prestandard has been superseded by the American Society of Civil Engineers (ASCE) 41 standard, "Seismic Rehabilitation of Buildings," but is being maintained by FEMA as a reference document.

https://www.fema.gov/media-library/assets/documents/757

FEMA 157 – *Typical Costs for Seismic Rehabilitation of Existing Buildings. Volume 2: Sup porting Documentation* (Second Edition, September 1995)

This companion volume to FEMA 156 provides an in-depth discussion of the approaches and methodology that were used in developing the second edition of FEMA 156.

https://www.fema.gov/media-library/assets/documents/2910

FEMA 156 – *Typical Costs for Seismic Rehabilitation of Existing Buildings. Volume 1: Summary* (Second Edition, December 1994)

This publication provides a methodology to estimate the costs of seismic rehabilitation projects at various locations in the United States. This edition is based on a sample of almost 2,100 projects, with data collected using a standard protocol, strict quality control verification, and a reliability rating. A sophisticated statistical methodology applied to this database yields cost estimates of increasing quality and reliability as more and more detailed information on the building inventory is used in the estimation process. Guidance is also provided to calculate the range of uncertainty associated with this process.

https://www.fema.gov/media-library/assets/documents/2905

FEMA 255 – *Seismic Rehabilitation of Federal Buildings: A Benefit/Cost Model. Volume 1: A User's Manual* (September 1994)

This user's manual and accompanying software present a second-generation benefit-cost model for the seismic rehabilitation of Federal and other government buildings. The benefit- cost methodology provides facility managers, design professionals, and other decision-makers with estimates of the benefits (avoided damages, losses, and casualties) of seismic rehabilitation and the costs of implementing rehabilitation. The methodology also generates detailed scenario estimates of damages, losses, and casualties. A tutorial and benefit-cost analyses of eight Federal buildings are included.

https://www.fema.gov/media-library/assets/documents/1887

FEMA 256 – *Seismic Rehabilitation of Federal Buildings: A Benefit/Cost Model. Volume 2: Supporting Documentation* (September 1994)

This document contains background information related to FEMA 255, including information on valuing public-sector services, discount rates and multipliers, the dollar value of human life, and technical issues that affect benefit-cost analysis, such as seismic risk assessment and sensitivity analysis.

https://www.fema.gov/media-library/assets/documents/1906

New Construction

FEMA P-1050 – *NEHRP Recommended Seismic Provisions for New Buildings and Other Structures* (2015 Edition, Coming in 2015)

The new Provisions will provide more than 40 recommended technical changes developed and consensually approved by the Provisions Update Committee, Issue Teams, and member organizations of the BSSC. The major changes include a complete rewrite of seismic-response-history procedures, revised soil structure interaction for seismic design, a new alternative diaphragm design procedure, revised design requirements for seismically isolated structures and structures with damping systems, updated site coefficients and new requirements for foundations on liquefiable sites, adoption of new U.S. Geological Survey (USGS) seismic hazard maps for seismic design, strength design of foundations, update of modal analysis procedure, adoption of methodologies as alternatives for seismic qualification of new systems and components, and a revision of the intent of the Provisions. New FEMA P-1051CD, 2015 NEHRP Recommended Seismic Provisions: Design Examples, and FEMA P-1052CD, 2015 NEHRP Recommended Seismic Provisions: Training and Instructional Materials, will be published in late 2015, early 2016.

FEMA P-753DVD – *2009 NEHRP Recommended Seismic Provisions for New Buildings and other Structures: A Compendium* (September 2014)

The 2009 NEHRP Recommended Seismic Provisions for New Buildings and Other Structures, FEMA P-750, is a widely recognized seismic code resource document. This new compendium resource, FEMA P-753 DVD, includes the 2009 NEHRP Recommended Seismic Provisions, FEMA P-750, and three supporting documents: FEMA P-749, Earthquake Resistant Design Concepts: An Introduction to the NEHRP Recommended Seismic Provisions for New Buildings and Other Structures; FEMA P-751CD, 2009 NEHRP Recommended Seismic Provisions: Design Examples; and FEMA P-752CD, 2009 NEHRP Recommended Seismic Provisions: Training and Instructional Materials.

FEMA P-752CD – *NEHRP Recommended Provisions for New Buildings and Other Structures: Training and Instructional Materials* (June 2013)

These instructional materials are for use with the "2009 NEHRP Recommended Seismic Provisions: Design Examples" (FEMA P-751) and provide a means for gaining additional knowledge about earthquake engineering as presented in the 2009 edition of the NEHRP Recommended Seismic Provisions (FEMA P-750). These materials can be presented to engineers or architects by a qualified speaker with expertise in the practice of earthquake engineering, used by an individual who wishes to enhance his or her understanding of earthquake engineering, or applied by engineering academics as the basis for classroom instruction on earthquake-resistant design.

https://www.fema.gov/media-library/assets/documents/30946

FEMA P-751CD – *2009 NEHRP Recommended Seismic Provisions: Design Examples* (September 2012)

This publication provides a series of design examples, based on the 2009 edition of the NEHRP Recommended Seismic Provisions (FEMA P-750), for different types of construction materials and building configurations. These examples demonstrate the design procedures used in FEMA P-750, which serves as the basis for the seismic provisions in the Nation's building codes, and make an excellent training tool. The examples are appropriate for a broad technical audience. College professors and students specializing in earthquake engineering, engineers studying for their license, and practicing engineers who want to keep up with the latest changes in design standards, should all find this document to be a useful accompaniment to FEMA P-750.

https://www.fema.gov/media-library/assets/documents/30946

FEMA P-795 and P-795CD – *Quantification of Building Seismic Performance Factors: Component Equivalency Methodology* (June 2011)

Published in 2011, this document builds upon an earlier FEMA publication, FEMA P-695. Although the methodology contained in FEMA P-695 provides a means to evaluate complete seismic-force-resisting systems proposed for adoption into building codes, a component-based methodology was needed to reliably evaluate structural elements, connections, or subassemblies proposed as substitutes for equivalent components in established seismic-force-resisting systems. The Component Equivalency Methodology presented in this document fills this need by maintaining consistency with the probabilistic, system-based col- lapse assessment concepts of FEMA P-695 while providing simple procedures for comparing the tested performance of different components. It is intended to be of assistance to organizations, such as the International Code Council Evaluation Service, that need to compare the seismic performance of alternate components to that of components in established seismic-force-resisting systems.

https://www.fema.gov/media-library/assets/documents/26842

FEMA P-749 – *Earthquake-Resistant Design Concepts: An Introduction to the NEHRP Recommended Seismic Provisions* (December 2010)

This document provides a readily understandable explanation of the intent and requirements of seismic design in general and the "NEHRP Recommended Seismic Provisions for New Buildings and Other Structures" (FEMA P-750) in particular. FEMA P-750 and the building codes and standards based on its recommendations are technical documents intended primarily for use by design and construction professionals. However, understanding the basis for the seismic regulations contained in the Nation's building codes and standards is important to many people outside this technical community. This publication is designed for elected officials, members of the insurance and financial communities, individual business owners, and other interested individuals.

https://www.fema.gov/media-library/assets/documents/21866

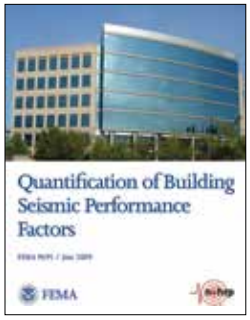
FEMA P-750 and P-750CD – *NEHRP Recommended Seismic Provisions for New Buildings and Other Structures* (2009 Edition, January 2010)

The NEHRP Recommended Seismic Provisions is a resource document for improving national seismic design standards and model building codes. It has been the primary source of seismic design requirements for model building codes and design standards since the early 1990s. This 2009 edition

is significantly different from previous editions in that the ASCE/Structural Engineering Institute (SEI) 7–05 standard, "Minimum Design Loads for Buildings and Other Structures," and the standards therein are adopted by reference, allowing this edition of the NEHRP Recommended Seismic Provisions to focus on introducing new concepts and design methods and translating research results for practical implementation. The document consists of three parts: Part 1 presents recommended modifications to ASCE/SEI 7–05, including new seismic design maps based on the USGS national seismic hazard maps; Part 2 is a completely rewritten commentary following the ASCE/SEI 7 chapter structure; and Part 3 contains 13 resource papers on emerging seismic design concepts and issues.

https://www.fema.gov/media-library/assets/documents/18152

FEMA P-695 and P-695CD – *Quantification of Building Seismic Performance Factors* (June 2009)



This publication presents a recommended methodology for reliably quantifying building system performance and response parameters for use in seismic design. The parameters or "seismic performance factors" addressed include the response modification coefficient (R factor), system overstrength factor, and deflection amplification factor. The methodology is a refinement of an earlier preliminary methodology, and is based on a review of relevant research on nonlinear response and collapse simulation, benchmarking studies of selected structural systems, feedback from an expanded group of experts and potential users, and evaluations of additional structural systems conducted to verify the technical soundness and applicability of the approach.

https://www.fema.gov/media-library/assets/documents/16648

FEMA 454CD – *Designing for Earthquakes: A Manual for Architects* (December 2006)

This manual explains the principles of seismic design in ways that are easy to understand for those without a technical background in engineering and seismology. Although intended primarily for architects, the publication may also be of interest to building officials, owners, managers, and tenants as well as emergency management personnel, engineers, and others concerned with the seismic protection of buildings. Topics covered include the nature of seismic hazards, how buildings are affected by earthquake-induced ground motion, building site selection and assessment, how design decisions affect building seismic performance, seismic codes and performance-based design, the historical development of earthquake-resistant design, common retrofit techniques for existing buildings, protection of nonstructural components, and how earthquake protection relates to protection from other hazards.

https://www.fema.gov/media-library/assets/documents/10672

FEMA 450 and 450CD – *NEHRP Recommended Provisions and Commentary for Seismic Regulations for New Buildings and Other Structures. 2003 Edition* (Third Edition, June 2004)

The 2003 edition of the NEHRP Recommended Provisions presents criteria for the design and construction of new buildings, additions and alterations to existing buildings, and non- building structures to enable them to resist the effects of earthquake ground motions. This edition has been superseded by the 2009 edition (FEMA P-750) but is still available to com ply with Executive Order 12699. This edition consists of two volumes: FEMA 450-1 (Part 1: Provisions) and FEMA 450-2 (Part 2: Commentary). Most of this material was adopted into the ASCE/SEI 7–05 standard and the 2006 edition of the International Building Code. FEMA 450CD contains FEMA 450–1 and FEMA 450–2 and the related seismic design maps, including the maximum considered earthquake (MCE) maps. The CD also includes the USGS design map value calculation software and two earlier editions of the NEHRP Recommended Provisions (1997 and 2000).

https://www.fema.gov/media-library/assets/documents/5543

FEMA 389 – *Communicating with Owners and Managers of New Buildings on Earthquake Risk* (January 2004)

This publication facilitates the education of building owners and managers on the seismic risk management tools that can be effectively and economically employed during the building development phase. The document, which is intended primarily for design professionals, introduces and discusses (1) seismic risk management and the development of a risk management plan; (2) emerging concepts in performance-based seismic design; and (3) seismic design and performance issues related to six specific building occupancies: commercial office facilities, retail commercial facilities, light manufacturing facilities, health care facilities, local schools (K–12), and higher education (university) facilities. The document also provides guidance for identifying and assessing earthquake-related hazards during the site selection process.

https://www.fema.gov/what-mitigation/fema-389-communicating-owners-and-managers-new-buildings-earthquake-risk-primer

Nonstructural Components

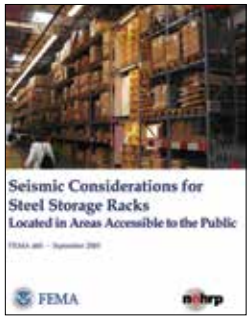
FEMA E-74CD – *Reducing the Risks of Nonstructural Earthquake Damage: A Practical Guide* (Fourth Edition, December 2012)

This fourth edition of FEMA 74 has been redesigned for use online and expanded to include more examples that feature photos of actual damage and details illustrating correct mitigation measures. The online format makes it

easy to browse and print out relevant details. The guide describes the sources of nonstructural earthquake damage and effective methods of reducing potential risks associated with such damage. It assists in identifying potential hazards and provides specific guidance on upgrades. The guide also contains a glossary, references, and an annotated bibliography for those who desire additional information. A nonstructural inventory form, a checklist of nonstructural earthquake hazards, and an explanation of nonstructural risk ratings are included as appendices. Target audiences for the guide include building owners, facility managers, maintenance personnel, homeowners, store or office managers, business proprietors, organizational department heads, and others concerned with building safety and the continuation of business.

https://www.fema.gov/media-library/assets/documents/21405?id=4626

FEMA 460 – *Seismic Considerations for Steel Storage Racks Located in Areas Accessible to the Public* (September 2005)



This report highlights issues for consideration in the seismic design, installation, ongoing inspection, maintenance, and use of steel pallet storage racks located in areas of retail warehouse stores and other facilities accessible to the general public. (The considerations apply only to single selective steel pallet storage racks with contents elevated 8 feet or more above the ground.) Included are a review of the performance of storage racks in past earthquakes; a history of the development of codes and standards used for storage-rack design; information on current storage-rack design practices; guidance on recommended performance goals and design requirements for storage racks; guidelines for implementation responsibilities associated with the specification, procurement, and installation of pallet storage racks; suggested guidance for securing contents; recommendations for operations and use; suggested guidance for quality assurance programs; a discussion of current and past storage-rack research and testing; suggestions for post-earthquake inspections; and proposed modifications to seismic design provisions and standards for racks. Most of the report is intended for all readers with an interest in the seismic protection of steel single selective pallet storage racks and their contents. Chapters 4 through 6 and Appendices A through Dare technical and will be of interest primarily to rack-design engineers and seismic code and standards writers.

https://www.fema.gov/media-library/assets/documents/873

FEMA 412 to FEMA 414 – *Installing Seismic Restraints*

These three fully illustrated guides show equipment installers how to attach mechanical equipment (FEMA 412), electrical equipment (FEMA 413), and duct and pipe (FEMA 414) to buildings to minimize earthquake damage. The guides describe various types of equipment and the methods used to install them, and for each installation method, identify the type of attachment needed. Step-by-step instructions and precautions for each type of attachment are included. Examples of anchoring and seismic-restraint devices; instructions for installing and attaching equipment in different configurations; and special cases for housekeeping pads, cable assemblies, supports for control panels, and residential equipment are also presented.

- FEMA 412 – *Installing Seismic Restraints for Mechanical Equipment* (August 2005)

  https://www.fema.gov/media-library/assets/documents/2142

- FEMA 413 – *Installing Seismic Restraints for Electrical Equipment* (January 2004)

  https://www.fema.gov/media-library/assets/documents/843

- FEMA 414 – *Installing Seismic Restraints for Duct and Pipe* (January 2004)

  https://www.fema.gov/media-library/assets/documents/848

Lifelines

FEMA 233 – *Earthquake Resistant Construction of Gas and Liquid Fuel Pipeline Systems Serving or Regulated by the Federal Government* (July 1992)

This document summarizes the vulnerability of gas and liquid-fuel pipeline systems to damage in past earthquakes. It lists the available standards and technologies that can protect such facilities against earthquake damage. An overview of measures taken by various Federal agencies to protect pipeline systems is presented. The appendix presents summaries of statements made by representatives of Federal agencies and other organizations contacted during the study.

https://www.fema.gov/media-library/assets/documents/2978

FEMA 226 – *Collocation Impacts on the Vulnerability of Lifelines during Earthquakes with Applications to the Cajon Pass, California* (February 1992)

This report presents a new analytical method for identifying the increase in the seismic vulnerability of individual lifeline systems (communication systems, electric power systems, fuel pipelines, and transportation lifelines) due to their proximity to other lifelines in the Cajon Pass. The method calculates a parameter that can be used to adjust the damage-state values for shaking as determined by the Applied Technology Council's ATC–13 damage probability matrices. The primary objective of the study was to determine how the time to restore full service would be affected by the collocation of several types of lifelines in the same congested corridor. The new method is applied to the Cajon Pass lifelines. The design program AutoCAD is used to develop overlays of the lifeline routes with seismic and geologic information presented in FEMA 225.

https://www.fema.gov/media-library/assets/documents/3684

FEMA 225 – I*nventory of Lifelines in the Cajon Pass, California* (February 1992)

This publication provides an inventory of the major lifeline systems in the Cajon Pass, and describes the earthquake and geologic analysis tools available to identify and define the level of seismic risk to those lifelines. It evaluates the vulnerabilities resulting from the siting of multiple lifeline systems in confined and at-risk areas and from potential interactions among these systems in natural and man-made disasters. Potential mitigation techniques for communication, electric power, fuel pipeline, and transportation lifelines are identified. Detailed maps indicate lifeline locations. The report also discusses seismic hazards and predictive models for evaluating the damage potentials associated with these hazards.

https://www.fema.gov/media-library/assets/documents/3671

FEMA 221 – *Collocation Impacts on the Vulnerability of Lifelines during Earthquakes with Applications to the Cajon Pass, California: Study Overview* (October 1991)

This report summarizes a study of lifeline systems located along the Cajon Pass in southern California. The study included analysis of communication, electric power, fuel pipeline, and transportation lifelines. This study overview describes how collocation may influence each lifeline's seismic vulnerability. A brief description of the screening tool developed during the study is provided.

https://www.fema.gov/media-library/assets/documents/2973

FEMA 224 – *Seismic Vulnerability and Impact of Disruption of Lifelines in the Conterminous United States* (September 1991)

This report provides a national overview of lifeline seismic vulnerability and the impacts of lifeline disruptions. Both site-specific lifelines and extended lifeline networks are examined. Included is a review of electrical, water, transportation, and emergency-service systems. The vulnerability estimates and impacts are presented in terms of estimated direct damage losses and indirect economic losses. The report also presents hazard mitigation measures and their expected benefits as well as recommendations for future work.

https://www.fema.gov/media-library/assets/documents/1738

FEMA 202 – *Earthquake Resistant Construction of Electric Transmission and Telecommunication Facilities Serving the Federal Government* (September 1990)

This report summarizes a National Institute of Standards and Technology study that reviewed measures implemented by Federal agencies to protect electric power transmission and telecommunication lifelines against seismic hazards. The report examines the seismic vulnerability of these lifelines and discusses current standards and design criteria. Seismic retrofitting techniques for components and systems are reviewed, including the benefits of retrofitting versus gradual replacement. A summary of Federal practices in the design of new facilities and the retrofit of existing facilities is included.

https://www.fema.gov/media-library/assets/documents/2964

Performance-Based Seismic Design

FEMA P-58-1 – *Seismic Performance Assessment of Buildings: Volume 1—Methodology* (May 2013)

This publication presents a methodology for assessing how well a building is likely to perform in an earthquake. The methodology expresses performance as the probable losses (casualties, repair costs, repair time, environmental impacts) resulting from earthquake-induced building damage. It takes into account the uncertainty that is inherent in predictions of future outcomes, and enables the sources of losses to be identified, which facilitates the refinement of building designs. Seismic performance assessments developed with this methodology will allow decision makers to more easily perform cost-benefit analyses and select appropriate performance goals for seismic design projects.

https://www.fema.gov/media-library/assets/documents/90380

FEMA P-58-2 – *Seismic Performance Assessment of Buildings: Volume 2—Implementation Guide* (May 2013)

Intended for building design professionals, this publication explains how to use the seismic performance assessment methodology that is described in FEMA P-58-1 (see above).

https://www.fema.gov/media-library/assets/documents/90380

FEMA P-58CD – *Seismic Performance Assessment of Buildings: Volume 3—Supporting Materials* (May 2013)

The FEMA P-58 CD contains the performance assessment methodology document (FEMA P- 58-1) and the accompanying implementation guide (FEMA P-58-2), as well as supporting electronic materials and background documents, including the Performance Assessment Calculation Tool (PACT) spreadsheet and information about environmental benefits.

FEMA P-440A – *Effects of Strength and Stiffness Degradation on Seismic Response* (June 2009)

This document is a follow-on publication to "Improvement of Nonlinear Static Seismic Analysis Procedures" (FEMA 440). It provides information that will improve nonlinear analysis for cyclic response, considering cyclic and in-cycle degradation of strength and stiffness. Recent work has demonstrated that it is important to be able to differentiate between cyclic and in-cycle degradation in order to more accurately model degrading behavior, while current practice only recognizes cyclic degradation, or does not distinguish between the two. The material contained within this publication is expected to improve nonlinear modeling of structural systems, and ultimately make the seismic retrofit of existing hazardous buildings more cost-effective.

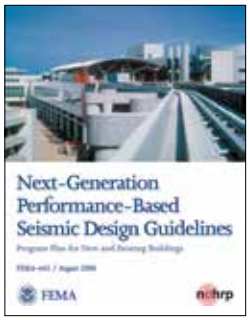
https://www.fema.gov/media-library/assets/documents/17037

FEMA 461 – *Interim Testing Protocols for Determining the Seismic Performance Characteristics of Structural and Nonstructural Components* (June 2007)

This publication was developed under FEMA's next-generation performance-based seismic design (PBSD) project with the ATC, and is one of the first major accomplishments achieved under the program plan described in FEMA 445. FEMA 461 provides methodologies that can be used to measure the seismic performance of buildings' structural or nonstructural components in a consistent and comparable manner. It describes in detail two laboratory testing protocols that determine fragility functions for various build-

ing systems and components. The first protocol, Quasi-Static Cyclic Testing of Structural and Nonstructural Components and Systems, can be used to test shear walls, beam-column assemblies, drywall partitions, cladding panels, pipes, ducts, and other elements whose behavior is sensitive to the relative motion of several floors or vertical connections within a building. The second protocol, Shake Table Testing of Structural and Nonstructural Components and Systems, is designed for testing mechanical and electrical equipment and other elements that are sensitive to the dynamic effects of motion imparted at a single point of attachment. Although these protocols are intended as interim methods that will be finalized over time as they are used and evaluated by researchers nationwide, they are nevertheless a significant step forward in the development of PBSD.

https://www.fema.gov/media-library/assets/documents/15207



FEMA 445 – *Next-Generation Performance-Based Seismic Design Guidelines: Program Plan for New and Existing Buildings* (August 2006)

This publication is a step-by-step program plan for the FEMA project with the Applied Technology Council to develop next-generation performance-based seismic design procedures and guidelines for structural and nonstructural components in new and existing buildings. The plan provides background information on current code design procedures, introduces performance-based seismic design concepts, identifies improvements needed in current seismic design practice, and outlines the tasks and projected costs for a two-phase program to develop next-generation performance-based seismic design procedures and guidelines.

https://www.fema.gov/media-library/assets/documents/9136

FEMA 440 and 440CD – *Improvement of Nonlinear Static Seismic Analysis Procedures* (June 2005)

This state-of-the-art resource captures the latest advances in nonlinear static analysis. It evaluates FEMA and ATC procedures for estimating the response of structures to ground shaking and attempts to address the significantly different results in estimates of maximum displacement that these procedures generate. This report sets the stage for future improvements to FEMA 356 or the ATC report, "Seismic Evaluation and Retrofit of Concrete Buildings" (ATC–40). FEMA 440CD contains the document (FEMA 440) and supplementary summaries in PDF files.

https://www.fema.gov/media-library/assets/documents/855

FEMA 349 – *Action Plan for Performance Based Seismic Design* (April 2000)

This document, published as a "final draft," explores the steps required to successfully implement PBSD. Topics discussed include the need for changes in current seismic design practice, the definition of performance-based design, and the products necessary for its effective adoption. These products include (1) a Planning and Management Program, (2) Structural Performance Products, (3) Nonstructural Performance Products, (4) Risk Management Products, (5) PBSD Guidelines, and (6) a Stakeholders' Guide. The costs involved in obtaining both a basic framework for PBSD implementation and full implementation of PBSD are also outlined. This document has been superseded by FEMA 445, but is being maintained by FEMA for reference purposes.

https://www.fema.gov/media-library/assets/documents/3123

Special Construction Types – Steel

FEMA 354 – *A Policy Guide to Steel Moment-Frame Construction* (November 2000)

This guide addresses the social, economic, and political issues related to the earthquake performance of steel moment-frame buildings. Written for building owners, local community officials, and other non-technical audiences, the guide also discusses the relative costs and benefits of implementing the design criteria recommended in FEMA 350 through FEMA 353.

https://www.fema.gov/media-library/assets/documents/752

FEMA 355CD – *Seismic Design Criteria for Steel Moment-Frame Structures* (September 2000)

This CD contains technical reports on the seismic design criteria, evaluation, repair, and specifications of steel moment-frame buildings. It includes four resource documents (FEMA 350 through FEMA 353) for the design, construction, repair, and upgrade of steel moment-frame structures subject to the effects of earthquakes. The CD also contains six reports (FEMA 355A–F) that provide detailed explanations of the basis for the design criteria and evaluation recommendations for base metals, welding, systems performance, connection performance, and past and predicted performance included in the resource documents.

FEMA 352 – *Recommended Postearthquake Evaluation and Repair Criteria for Welded Steel Moment-Frame Buildings* (July 2000)

This report provides recommendations for performing inspections to detect damage in steel moment-frame buildings following an earthquake; evaluating the safety of damaged buildings in a postearthquake environment; and repairing damaged buildings. Chapters cover inspection and classification of damage; preliminary postearthquake assessment; detailed postearthquake evaluations; and postearthquake repair. The appendices include procedures for performance evaluation; sample placards that may be used to post buildings following preliminary postearthquake evaluations; and sample inspection forms that may be used to record damage detected in beam-column connections as part of a detailed postearthquake inspection program.

https://www.fema.gov/media-library/assets/documents/747

FEMA 350 – *Recommended Seismic Design Criteria for New Steel Moment-Frame Buildings* (June 2000)

This resource document for organizations engaged in the development of building codes and standards provides recommended guidelines for the design and construction of steel moment- frame buildings and alternative performance-based design criteria. It supplements the "NEHRP Recommended Seismic Provisions for New Buildings and Other Structures" (FEMA P-750). A series of prequalified connection details, as well as a detailed procedure for performance evaluation, are included.

https://www.fema.gov/media-library/assets/documents/2098

FEMA 351 – *Recommended Seismic Evaluation and Upgrade Criteria for Existing Welded Steel Moment-Frame Buildings* (June 2000)

This publication provides recommended methods for evaluating the probable performance of existing steel moment-frame buildings in future earthquakes. It presents guidelines on how to retrofit these buildings for improved performance, a simplified procedure for estimating the probable post-earthquake repair costs, and methods for developing building-specific vulnerability and loss functions for steel moment-frame buildings.

https://www.fema.gov/media-library/assets/documents/3736

FEMA 353 – *Recommended Specifications and Quality Assurance Guidelines for Steel Moment-Frame Construction for Seismic Applications* (June 2000)

This two-part publication provides recommended specifications for the fabrication and erection of steel moment-frames for seismic applications. Part One covers recommended specifications, including information on products, execution, welded joint and fabrication details, and quality control and assurance. Part Two outlines quality-assurance guidelines; contractor qualifications and quality tasks; quality-assurance agency qualifications and quality- assurance tasks; and recommended methods for determining whether structural steel materials, welded joints, and bolted joints meet the applicable standards. The recommended design criteria contained in FEMA 350, FEMA 351, and FEMA 352 are based on the standards presented in this document.

https://www.fema.gov/media-library/assets/documents/2103

Special Construction Types – Concrete

FEMA 306 and FEMA P-306/307/308CD – *Evaluation of Earthquake Damaged Concrete and Masonry Wall Buildings: Basic Procedures Manual* (May 1999)

This document provides practical criteria and guidance for evaluating earthquake damage to concrete and masonry-wall buildings. Component Damage Classification Guides and Test and Investigation Guides are included. Detailed drawings accompany the text.

https://www.fema.gov/media-library/assets/documents/3068

FEMA 307 – *Evaluation of Earthquake Damaged Concrete and Masonry Wall Buildings: Technical Resources* (May 1999)

This publication provides background and theoretical information to be used in conjunction with FEMA 306. Analytical and experimental findings are included, as well as information on the Component Damage Classification Guides.

https://www.fema.gov/media-library/assets/documents/3073

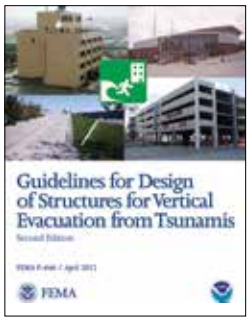
FEMA 308 – *The Repair of Earthquake Damaged Concrete and Masonry Wall Buildings* (May 1999)

This document provides practical guidance for the repair and upgrade of earthquake-damaged concrete and masonry-wall buildings. Audiences

include design engineers, building owners and officials, insurance adjusters, and government agencies. The publication contains sections on performance-based repair design, repair technologies, categories of repair, nonstructural considerations, and repair guides.

https://www.fema.gov/media-library/assets/documents/2002

Special Construction Types – Tsunami-Resistant Construction



FEMA P-646 – *Guidelines for Design of Structures for Vertical Evacuation from Tsunamis* (Second Edition, April 2012)

Vertical evacuation is an issue raised by the National Tsunami Hazard Mitigation Program, and driven by the fact that there are many coastal communities that are vulnerable to a near- source tsunami and are located in areas that would be impossible to evacuate quickly enough to avoid a large loss of life. Vertical evacuation structures provide a means to create areas of refuge within the tsunami inundation zone for communities in which evacuation out of the zone is not feasible. This document provides information and guidance on the following topics to assist in the planning and design of tsunami vertical evacuation structures: the tsunami hazard and its history; determining the tsunami hazard, including tsunami depth and velocity; different options for tsunami vertical evacuation structures; siting, spacing, sizing, and elevation considerations; determining tsunami and earthquake loads and related structural design criteria; and structural design concepts and other considerations. This second edition of this publication includes lessons learned from the March 2011 Japan tsunami as well as corrections to errors found in the first edition's debris impact load calculations.

https://www.fema.gov/media-library/assets/documents/14708

Special Construction Types – Blast Resistance Benefits of Seismic Design

FEMA P-439B – *Blast Resistance Benefits of Seismic Design. Phase 2 Study: Performance Analysis of Steel Frame Strengthening Systems* (November 2010)

This is the second publication that was developed in response to the September 11, 2001, terrorist attacks to examine whether lessons learned from natural hazards could be applied to ef fectively protect building occupants from man-made threats (see FEMA 439A). The study described in this document duplicated the Phase 1 Murrah Federal Building study in FEMA 439A, except that a steel frame building was examined instead of a reinforced concrete structure. A federally owned steel frame building located in an area of low seismic haz-

ard was selected and a series of seismic strengthening designs was developed, based on the original plans. The original building and the seismically strengthened designs were then evaluated using the same blast characteristics and modeling used in the Phase 1 study. The results were even more encouraging than in the first study and demonstrated that, at least for this one example, a seismically strengthened steel frame building can provide a significant amount of resistance and redundancy.

http://www.fema.gov/media-library-data/20130726-1833-25045-0079/fema_p_439b.pdf

FEMA 439A CD – *Blast Resistance Benefits of Seismic Design. Phase 1 Study: Performance Analysis of Reinforced Concrete Strengthening Systems Applied to the Murrah Federal Building Design* (December 2005)

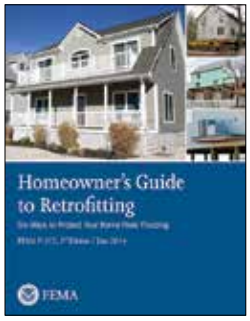
This is one of two publications developed in response to the September 11, 2001, terrorist attacks that explore whether lessons learned from natural hazards could be applied to effectively protect building occupants from man-made threats. Important similarities between seismic and blast loadings lend themselves to such examination. This first publication was developed for reinforced concrete buildings using the bombing of the Alfred P. Murrah Federal Building in Oklahoma City in April 1995. This report demonstrates that, with such seismic design features in place, the structural system would have been better able to dissipate and manage the blast load effects.

FLOOD PUBLICATIONS

INDIVIDUALS & HOMEOWNERS

Protecting Property

FEMA P-312 – *Homeowner's Guide to Retrofitting: Six Ways to Protect Your Home From Flooding* (Third Edition – June 2014)



This guide was prepared specifically for homeowners who want to know how to protect their homes from flooding. As a homeowner, you need clear information about the options available to you and straightforward guidance that will help you make decisions. This guide gives you both, in a form designed for readers who have little or no experience with flood protection methods or building construction techniques.

http://www.fema.gov/media-library/assets/documents/480

ABCs of Returning to Flooded Buildings (November 2012)

Returning to flood damaged buildings requires careful planning. The tips contained in this flyer are designed to assist impacted individuals when they are able to reach their flooded property.

http://www.fema.gov/media-library/assets/documents/29834

Hurricane Sandy Issue Paper - Guidance for Turning the Power Back On (November 2012)

This document contains guidance on the steps that should be taken during and after a power outage.

http://www.fema.gov/media-library/assets/documents/29788

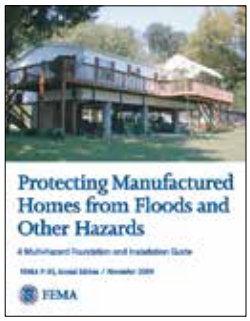
Protect Your Property From Flooding (April 2011)

These four publications offer information on how protecting your property from flooding can involve a variety of actions, from inspecting and maintaining the building to installing protective devices. Most of these actions, especially those that affect the structure of your building or its utility sys-

tems, should be carried out by qualified maintenance staff or professional contractors licensed to work in your state, county, or city.

1. *Install Sewer Backflow Valves*
2. *Anchor Fuel Tanks*
3. *Raise Electrical System Components*
4. *Build With Flood Damage Resistant Materials*

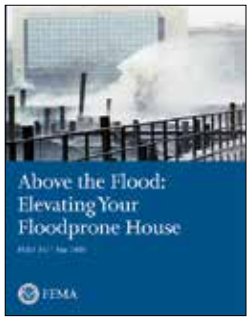
https://www.fema.gov/media-library/assets/documents/13261



FEMA P-85 – *Protecting Manufactured Homes from Floods and Other Hazards (Second Edition, November 2009)*

This publication provides guidance for prospective homeowners, contractors, and local officials for the installation of manufactured homes in Special Flood Hazard Areas (SFHAs). Manufactured homes have unique challenges related to water intrusion into the structure. This publication addresses recommendations for foundation construction for this popular style of home.

http://www.fema.gov/media-library/assets/documents/2574



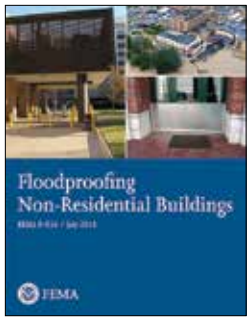
FEMA 347 – *Above the Flood: Elevating Your Floodprone House* (May 2000)

This publication shows how floodprone houses in south Florida were elevated above the 100-year flood level following Hurricane Andrew and also presents alternative elevation techniques.

http://www.fema.gov/media-library/assets/documents/725

PRIVATE SECTOR & SMALL BUSINESS

FEMA P-936 – *Floodproofing Non-Residential Buildings* (July 2013)



The primary focus of this guidance document is on dry floodproofing technologies for non-residential buildings, but it also includes an overview of other techniques including wet floodproofing and the use of levees and floodwalls. The publication provides information about regulatory requirements, design considerations, and descriptions of floodproofing methods and equipment. Key document features include: 1) Tools to assist the designer or building owner in determining the best floodproofing option for a particular building including a vulnerability checklist, 2) Case studies providing examples of applied floodproofing techniques, 3) Equations for determining flood forces and loads, 4) A summary of results from recent dry floodproofing research and testing for new construction.

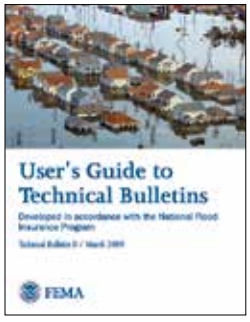
https://www.fema.gov/media-library/assets/documents/34270

Protect Your Property From Flooding (April 2011)

These four publications offer information on how protecting your property from flooding can involve a variety of actions, from inspecting and maintaining the building to installing protective devices. A more detailed listing of each item in this series can be found in this catalog under "Individuals and Homeowners – Protecting Property" on page 41.

https://www.fema.gov/media-library/assets/documents/13261

NFIP Technical Bulletins



The Technical Bulletins provide guidance concerning the building performance standards of the NFIP, which are contained in Title 44 of the U.S. Code of Federal Regulations at Section 60.3. A more detailed listing of each technical bulletin in this series can be found in this catalog under "Building Professionals and Engineers – NFIP Technical Bulletins" on page 55.

https://www.fema.gov/floodplain-management/nfip-technical-bulletins

FEMA P-348 – *Protecting Building Utilities From Flood Damage: Principles and Practices for the Design and Construction of Flood Resistant Building Utility Systems* (November 1999)

The overall objective of this publication is to assist in the construction of buildings with building utility systems that are designed and built so that the buildings can be re-occupied and fully operational as soon as electricity, sewer, and water are restored to the neighborhood.

The intended users of this manual are developers, architects, engineers, builders, code officials, and homeowners who are involved in designing and constructing building utility systems for residential and non-residential structures. This manual discusses flood protective design and construction of utility systems for new buildings and modifications to utility systems in existing buildings.

http://www.fema.gov/media-library/assets/documents/3729

COMMUNITY PLANNING & POLICY

Design and Construction Guidance

FEMA P-950 CD – *FEMA Building Science Toolkit CD* (March 2015)

The FEMA Building Science Toolkit CD contains some of the key resources, organized by hazard, from the Building Science Library and links to additional resources.

The Building Science Toolkit CD contains:

- General information and technical guidance for State and local officials on the design and construction of hazard-resistant buildings and the retrofit of existing buildings to reduce the risk of damage from flooding and other natural hazards
- Fifty-nine of the most widely used FEMA publications including design manuals, tools for assessing damage, technical bulletins, recovery advisories, best practices, and evaluations and comparisons of building codes
- Links to additional publications on hazard resistance and design prepared by FEMA and other Federal agencies.

The resources cited on the CD can be used with flood risk maps and other Risk Mapping, Assessment, and Planning (Risk MAP) products by local officials, developers, contractors and building owners to better define areas of mitigation interest, determine flood depth and velocity data needed for building design, and determine where hydraulic analyses should be conducted to assist with siting, foundation, and structure design. Distribution of the Toolkit CD is encouraged during the Risk MAP Community Engagement and Resilience meetings between FEMA and communities.

http://www.fema.gov/media-library/assets/documents/92819

Guidance for Applying ASCE 24 Engineering Standards to HMA Flood Retrofitting and Reconstruction Projects (November 2013)

FEMA's Hazard Mitigation Assistance (HMA) program provides funding for mitigation activities that reduce disaster losses and protect life and property from future disaster damages including the Hazard Mitigation Grant Program (HMGP), Pre-Disaster Mitigation (PDM), and Flood Mitigation Assistance (FMA). An important part of funding mitigation projects involves ensuring that each project meets FEMA's requirements, which includes adhering to project-related design standards. Specifically for flood-related HMA projects, FEMA requires projects to incorporate the American Society of Civil

Engineers Flood-Resistant Design and Construction Standard (ASCE 24). In order to integrate ASCE 24 as the minimum standard for flood-related HMA projects, FEMA Building Science Branch has developed a guidance document, methodology and checklists, and a training to compliment FEMA Policy-203-074-1, "Minimum Design Standards for Hazard Mitigation Assistance Projects in Flood Hazard Areas." Appendix C and Appendix D are spreadsheet tools and must be downloaded separately.

https://www.fema.gov/media-library/assets/documents/93594

Best Practices for Incorporating Building Science Guidance into Community Risk MAP Implementation (December 2012)

The Building Science Branch provides communities with guidance on reducing flood risk through publications, education, and tools that can be used with the Risk MAP program to help communities implement hazard-resistant construction. Building Science resources can be used in conjunction with Risk MAP products to strengthen the community's ability to reduce risk by increasing design standards for new construction and by implementing mitigation measures for existing construction.

The key Building Science topics for regulatory and non-regulatory Risk MAP products are (1) increasing the community's risk awareness and (2) informing the community of the vast array of FEMA Building Science resources (publications, training, brochures, and websites). These products can benefit the community by increasing their understanding of floods and how to mitigate the risk. This information plays an important role in determining the appropriate standards for new construction, how existing structures can be retrofitted to reduce future flood damage, and the benefits of enhancing or updating building codes to reduce the community's risk.

https://www.fema.gov/media-library/assets/documents/29942

Recommended Procedures for Flood Velocity Data Development (December 2012)

This report highlights recommended procedures for developing flood velocity data within the context of FEMA's efforts related to Risk MAP Program and FEMA's Building Science Branch. Report sections provide detailed descriptions of velocity grid development and considerations for one-dimensional (1D), two-dimensional (2D), and three-dimensional (3D) models.

https://www.fema.gov/media-library/assets/documents/29944

FEMA L-782 – *Building Science for Disaster-Resistant Communities: Flood Hazard Publications* (November 2011)

This brochure provides readers with a quick summary of publications that will help them prepare for and mitigate against flood hazards.

Buildings located in flood hazard areas are at risk from forces generated by floodwaters. These forces can include hydrostatic forces from slow moving floodwaters, hydrodynamic forces from waves and quickly moving water, as well as scour around building elements, erosion, and flood-borne debris.

http://www.fema.gov/media-library/assets/documents/21155

FEMA P-758 – *Substantial Improvement/Substantial Damage Desk Reference* (May 2010)

The *Substantial Improvement/Substantial Damage Desk Reference* is designed as a comprehensive resource for local officials who are responsible for the administration of local codes and ordinances, including the Substantial Improvement/Substantial Damage requirements. It also is intended for state officials who provide technical assistance to communities on the NFIP. Incorporating diagrams, decision charts, illustrations, and examples, the Substantial Improvement/Substantial Damage Desk Reference is designed to clearly communicate responsibilities and strategies for administering this important NFIP requirement.

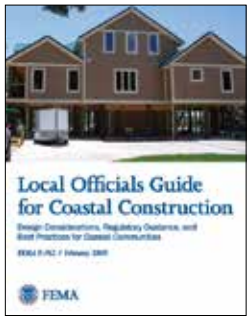
http://www.fema.gov/media-library/assets/documents/18562

FEMA B-797 – *Hazard Mitigation Field Book: Roadways* (May 2010)

This publication helps local government entities choose the best hazard mitigation solution(s) given their operational constraints and design considerations. By offering the user a quick selection tool, based on broad characteristics, the field book reduces a wide array of technical solutions to a few practical options. Although there are many causes of damage to roadways, this field book focuses primarily on flood-related causes of damage.

http://www.fema.gov/media-library/assets/documents/19299

FEMA P-762 – *Local Officials Guide for Coastal Construction* (February 2009)



This guide was developed to assist building officials in understanding the connection between NFIP guidelines and applicable building codes and standards. It also explores evidence collected following recent storm events and recommends "best practices" where appropriate. The focus of this guide

is on residential buildings, including detached single-family structures (three or fewer stories).

http://www.fema.gov/media-library/assets/documents/16036

FEMA 551 – *Selecting Appropriate Mitigation Measures for Floodprone Structures* (May 2007)

This manual is intended to provide guidance to community officials for developing mitigation projects that reduce or eliminate identified risks for floodprone structures.

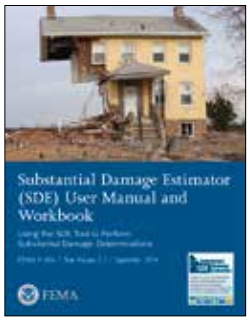
https://www.fema.gov/media-library/assets/documents/10618

Flood Hazard Mitigation Handbook for Public Facilities (June 2001)

This handbook is intended to aid local jurisdictions in identifying a variety of feasible mitigation ideas that can be implemented during the rebuilding process. It focuses on projects commonly eligible for hazard mitigation funding under the Public Assistance (PA) Program.

http://www.fema.gov/media-library/assets/documents/16572

Damage Assessment Tools

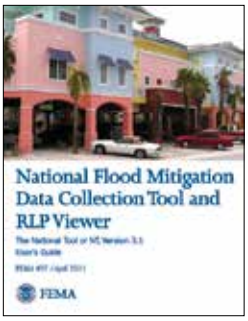


FEMA P-784 – *The FEMA Substantial Damage Estimator* (SDE) (Version 2.1, September 2014)

The SDE 2.1 Tool was developed by FEMA to assist State and local officials in determining Substantial Damage for residential and non-residential structures in accordance with a local floodplain management ordinance meeting the requirements of the NFIP. The tool can be used to assess flood, wind, wildfire, seismic, and other forms of damage. It helps communities provide timely Substantial Damage determinations so that reconstruction can begin following a disaster.

http://www.fema.gov/media-library/assets/documents/18692

FEMA 497 – *National Flood Mitigation Data Collection Tool and Repetitive Loss Property* (RLP) Viewer (April 2011)



The *National Flood Mitigation Data Collection Tool* (abbreviated as NFMDCT and referred to as the National Tool or NT) was developed for nationwide use to gather information about flood-prone structures in order to determine potentially appropriate long-term mitigation measures. The ultimate goal of the NT is to provide a standardized, systematic approach to collecting and interpreting property data and mitigation project development.

While the focus of the NT is on data collection for repetitive loss (RL) properties, it can be used to gather information related to flood risk, building construction, and building value for any structure. The NT is designed to encourage a comprehensive sweep for information pertinent to each structure. Data fields within the NT require information from a variety of sources, including NFIP policy information; community building, tax, and historical flood records; and field reconnaissance. Having detailed data helps create a clearer picture of the property and its flooding issues, which is important in determining the most appropriate and cost-effective mitigation method. However, the NT can also be used for more cursory or limited data collection efforts as appropriate.

The *RLP Viewer* 2.0 is a standalone application capable of connecting to any standard NT database in Access format (.MDB) that uses geographic information system (GIS) to display point features representing flood-prone properties. The *NT User's Guide* provides assistance in using both tools.

http://www.fema.gov/media-library/assets/documents/966

BUILDING PROFESSIONALS & ENGINEERS

Building Code Resources

Highlights of ASCE 24, Flood Resistant Design and Construction (December 2010, February 2015)

ASCE 24-14: ASCE 24-14 is a referenced standard in the 2015 International Building Code® (IBC) and the 2015 International Residential Code® (IRC). Building and structures within the scope of the IBC proposed to be constructed in flood hazard areas must be designed in accordance with ASCE 24-14. The IRC requires dwellings in floodways to be designed in accordance with ASCE 24-14 and includes an alternative that allows communities to require homes in any flood zone to be designed in accordance with ASCE 24-15. Highlights of ASCE 24-14 that complement the NFIP minimum requirements include: Building Performance; Flood-Damage Resistant Materials; Utilities and Service Equipment and Siting Considerations.

ASCE 24-05: ASCE 24-05 is a referenced standard in the International Building Code® and International Residential Code® (editions published 2012, 2009 and 2006). Building and structures within the scope of the IBC proposed to be constructed in a flood hazard area must be designed in accordance with ASCE 24. The IRC requires that dwellings in floodways to be designed in accordance with ASCE 24, and the 2012 and 2009 editions include an alternative that allows communities to require homes in Zones V to be designed in accordance with ASCE 24. Highlights of ASCE 24 that complement the NFIP minimum requirements include: Building Performance; Flood-Damage Resistant Materials; Utilities and Service Equipment; and Siting Considerations.

http://www.fema.gov/media-library/assets/documents/14983

Reducing Flood Losses Through the International Codes: Coordinating Building Codes and Floodplain Management Regulations (Fourth Edition 2014)

Developed by the International Code Council and FEMA, this guide helps State and local officials integrate the International Codes® (I-Codes) into their current floodplain management regulatory processes related to structures, buildings, and other development in special flood hazard areas in order to meet the requirements to participate in the NFIP. Chapter 2 describes three approaches for coordinating the I-Codes and local floodplain management regulations and identifies a number of advantages and considerations when relying on the flood provisions of the codes. Chapter 3 explains several differences between the NFIP regulations and the I-Code requirements related to specific terminology and provisions. Many requirements in the codes

exceed NFIP minimum requirements, and some provisions are more specific than the NFIP, especially in the International Building Code®, which references ASCE 24, Flood Resistant Design and Construction. Chapter 4 contains questions for States and communities to answer to know whether and how to modify existing floodplain management regulations to coordinate with the I-Codes. Chapter 5 describes modifications that can be adopted to incorporate higher standards in the I-Codes to further increase resistance to flood damage. Chapter 6 introduces model code-coordinated ordinances prepared by FEMA. The model ordinances are available at: http://www.fema.gov/media-library/assets/documents/96224.

https://www.fema.gov/media-library/assets/documents/96634

Flood Resistant Provisions of the 2015 International Codes (January 2014)

This document is a compilation of flood resistant provisions, prepared by FEMA, of the 2015 I-Codes (As of January 2014, this document covers the provisions of the IBC and IRC. Additional I-Codes may be added at a later date). Also included, as a separate document, is a summary of changes from the 2012 I-Codes. The 2015 edition of the I-Codes contains provisions that are consistent with the minimum flood-resistant design and construction requirements of the NFIP for buildings and structures.

https://www.fema.gov/media-library/assets/documents/100537

Guidance for Applying ASCE 24 Engineering Standards to HMA Flood Retrofitting and Reconstruction Projects (November 2013)

FEMA's Hazard Mitigation Assistance (HMA) program provides funding for mitigation activities that reduce disaster losses and protect life and property from future disaster damages including the Hazard Mitigation Grant Program (HMGP), Pre-Disaster Mitigation (PDM), and Flood Mitigation Assistance (FMA). An important part of funding mitigation projects involves ensuring that each project meets FEMA's requirements, which includes adhering to project-related design standards. Specifically for flood-related HMA projects, FEMA requires projects to incorporate the American Society of Civil Engineers Flood-Resistant Design and Construction Standard (ASCE 24). In order to integrate ASCE 24 as the minimum standard for flood-related HMA projects, FEMA Building Science Branch has developed a guidance document, methodology and checklists, and a training to compliment FEMA Policy-203-074-1, "Minimum Design Standards for Hazard Mitigation Assistance Projects in Flood Hazard Areas." Appendix C and Appendix D are spreadsheet tools and must be downloaded separately.

https://www.fema.gov/media-library/assets/documents/93594

Including Building Codes in the National Flood Insurance Program (November 2013)

The report presents findings of the impact, effectiveness, and feasibility of including widely used and nationally recognized building codes as part of the NFIP floodplain management criteria in response to the Biggert-Waters Flood Insurance Reform Act of 2012 (BW12). This resource will help floodplain managers and building officials understand impacts of the new statutory potential future affiliation between building codes and the NFIP. It also explains long term benefits of this provision of BW12 in decreasing both flood losses and flood insurance rates, by bringing NFIP building standards up to date with hazard provisions of the I-Codes. A flyer about this document can be located here: https://www.fema.gov/media-library/assets/documents/89851.

http://www.fema.gov/media-library/assets/documents/85960

NFIP 2012 I-Codes and ASCE 24 Checklist (November 2013)

This checklist can be used to guide floodplain managers, building officials, and designers as they compare the flood provisions of the 2012 I-Codes and ASCE 24, *Flood Resistant Design and Construction*, to the minimum requirements of the NFIP. It is based on the standard checklist used by FEMA and States to review local floodplain management regulations/ordinances to determine whether such regulations and ordinances are complete for the purpose of participating in the NFIP.

http://www.fema.gov/media-library/assets/documents/85588

Flood Provisions of the International Code Series: Higher Standards and More Specific Requirements than the Minimum Requirements of the National Flood Insurance Program (June 2013)

This paper summarizes the provisions of the I-Codes that are more detailed or that exceed the NFIP minimums.

https://www.fema.gov/media-library/assets/documents/33389

NFIP 2009 I-Codes and ASCE 24 Checklist (May 2013)

This checklist can be used to guide floodplain managers, building officials, and designers as they compare the flood provisions of the 2009 I-Codes and ASCE 24, *Flood Resistant Design and Construction*, to the minimum requirements of the NFIP. It is based on the standard checklist used by FEMA and States to

review local floodplain management regulations/ordinances to determine whether such regulations and ordinances are complete for the purpose of participating in the NFIP.

https://www.fema.gov/media-library/assets/documents/33391

Flood Resistant Provisions of the 2012 Uniform Codes by the International Association of Plumbing and Mechanical Officers (IAPMO) (January 2013)

This document contains Flood Resistant Provisions of the 2012 editions of codes published by IAPMO: the Uniform Mechanical Code; Uniform Plumbing Code, Uniform Swimming Pool, Spa and Hot Tub Code; and Uniform Solar Energy Code.

https://www.fema.gov/media-library/assets/documents/29689

Quick Reference Guide: Comparison of Select NFIP & Building Code Requirements for Special Flood Hazard Areas (March 2012)

This guide illustrates the similarities and highlights the differences between the NFIP minimum requirements and the requirements of the I-Codes and ASCE 24, a standard referenced by the I-Codes. The illustrations highlight some of the key similarities and differences between foundation types, lowest floor elevations, enclosures below elevated buildings and utilities requirements contained within the NFIP and I-Codes for most residential and commercial buildings (classified as "Category II" structures by the building codes).

https://www.fema.gov/media-library/assets/documents/25986

Flood Resistant Provisions of the 2012 International Codes (January 2012)

This document is a compilation of flood resistant provisions, prepared by FEMA, of the 2012 International Codes. Also included, as a separate document, is a summary of changes from the 2009 IBC. The 2012 edition of the I-Codes contains provisions that are consistent with the minimum flood-resistant design and construction requirements of the NFIP for buildings and structures.

http://www.fema.gov/media-library/assets/documents/24124

Flood Resistant Provisions of the 2009 International Codes (January 2011)

This document is a compilation of flood resistant provisions, prepared by FEMA, of the 2009 International Codes. Also included, as a separate document, is a summary of changes from the 2006 IBC. The 2009 edition of the I-Codes contains provisions that are consistent with the minimum flood-resistant design and construction requirements of the NFIP for buildings and structures.

http://www.fema.gov/media-library/assets/documents/21130

Provisions of the 2009 I-Codes and ASCE 24 Compared to the NFIP (January 2011)

This document is a comparison of the provisions of the 2009 I-Codes/ASCE 24-05 and the NFIP requirements.

http://www.fema.gov/media-library/assets/documents/21135

CodeMaster for Flood Resistant Design (2011)

In cooperation with the International Code Council and S.K. Ghosh Associates, FEMA has produced an 8-page laminated guide to flood-resistant design. The CodeMaster provides designers with an easy-to-use desk reference that identifies the flood provisions in the 2009 and 2012 IBC® and International Residential Code® (IRC®), as well as the flood requirements of ASCE standards 7-05, 7-10, and 24-05. The CodeMaster is a unique and useful tool for designers to make sure that they incorporate the flood-resistant provisions of these codes and standards. The 8-page guide provides sections on preliminary considerations and design process, key flood terminology, a 12-step process to incorporate flood resistance in the design of a building, an example showing the 12-step process being executed, and information on additional FEMA mitigation resources related to flood-resistant design. The document also uses illustrations to ensure a clear understanding for users in the professional community.

http://shop.iccsafe.org/codemaster-flood-resistant-design-2009-2012-ibc-2009-2012-irc-asce-7-05-7-10-asce-24-05.html

2006 Evaluation of the National Flood Insurance Program's Building Standards (October 2006) and 2008 Supplement to the 2006 Evaluation of the National Flood Insurance Program's Building Standards (2008)

The 2006 study evaluates the NFIP building standards, including a review of flood loss and damage data for structures and communities and calculation of costs and benefits of modifying NFIP building standards across defined ranges of flood conditions and building configurations, differentiated by flood hazard zone.

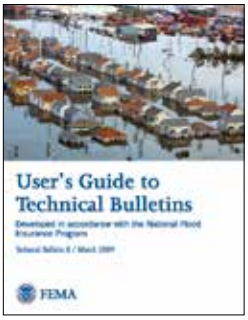
The 2008 document provides a supplement analysis to the 2006 study. The purpose of this document is to determine the cost-effectiveness of including freeboard within the foundation height of new residential buildings constructed in floodplains and to establish which factors should be considered when determining how many feet above the minimum NFIP-required elevation a house should be constructed in order to maximize cost-effectiveness.

2006 study: **https://www.fema.gov/media-library/assets/documents/9585**

2008 supplement: **https://www.fema.gov/media-library/assets/documents/31735**

NFIP Technical Bulletins

TB-0 – Technical Bulletin 0 – *User's Guide to Technical Bulletins* (March 2009)



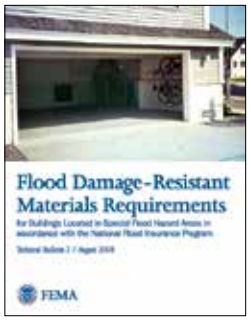
This Technical Bulletin provides a list of available technical bulletins, a key word/subject reference index for all of the bulletins, and information about how to obtain copies of the bulletins.

http://www.fema.gov/media-library/assets/documents/1169

TB-1 – Technical Bulletin 1 – *Openings in Foundation Walls of Enclosures* (August 2008)

This Technical Bulletin provides guidance on the NFIP regulations concerning the requirements for openings in foundation walls for buildings with enclosures below the base flood elevation (BFE) and located in SFHAs shown on Flood Insurance Rate Maps (FIRMs) as Zones A, AE, A1-A30, AR, AO, and AH.

http://www.fema.gov/media-library/assets/documents/2644



TB-2 – Technical Bulletin 2 – *Flood Damage-Resistant Materials Requirements* (August 2008)

This Technical Bulletin provides guidance on the NFIP regulations concerning the required use of flood damage-resistant construction materials for building components located below the BFE in SFHAs in both A and V zones.

http://www.fema.gov/media-library/assets/documents/2655

FIA-TB-3 – *Non-Residential Floodproofing – Requirements and Certification* (April 1993)

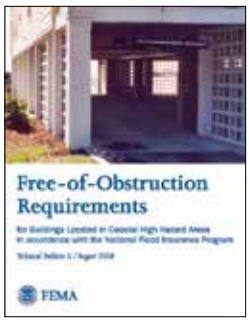
This Technical Bulletin provides guidance on the NFIP regulations concerning watertight construction and the required certification for floodproofed non-residential buildings in Zones A, AE, A1-A30, AR, AO, and AH whose lowest floors are below the BFE.

http://www.fema.gov/media-library/assets/documents/3473

TB-4 – Technical Bulletin 4 – *Elevator Installation* (November 2010)

This Technical Bulletin provides guidance on the NFIP regulations concerning the installation of elevators below the BFE in Special Flood Hazard Areas (both A and V zones).

http://www.fema.gov/media-library/assets/documents/3478



TB-5 – Technical Bulletin 5 – *Free-of-Obstruction Requirements* (August 2008)

This Technical Bulletin provides guidance on the NFIP regulations concerning obstructions to floodwaters below elevated buildings and on building sites in Coastal High Hazard Areas (Zones V, VE, and V1-V30).

http://www.fema.gov/media-library/assets/documents/3490

FIA-TB-6 – *Below-Grade Parking Requirements* (April 1993)

This Technical Bulletin provides guidance on the NFIP regulations concerning the design of below-grade parking garages beneath buildings located in Zones A, AE, A1-A30, AR, AO, and AH.

http://www.fema.gov/media-library/assets/documents/3498

FIA-TB-7 – *Wet Floodproofing Requirements* (December 1993)

This Technical Bulletin provides guidance on the NFIP regulations concerning wet floodproofing of certain types of structures located in Zones A, AE, A1-A30, AR, AO, and AH.

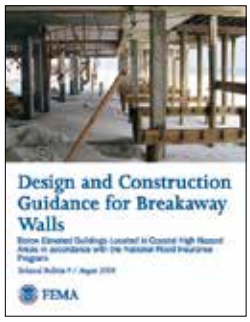
http://www.fema.gov/media-library/assets/documents/3503

FIA-TB-8 – *Corrosion Protection for Metal Connectors in Coastal Areas* (August 1996)

This Technical Bulletin provides guidance on the need for, selection of, and use of corrosion-resistant metal connectors for the construction of buildings in coastal areas.

http://www.fema.gov/media-library/assets/documents/3509

TB-9 –Technical Bulletin 9 – *Design and Construction Guidance for Breakaway Walls* (August 2008)



This Technical Bulletin provides prescriptive criteria for the design and construction of wood-frame and masonry breakaway walls beneath elevated buildings in Coastal High Hazard Areas compliant with NFIP regulatory requirements.

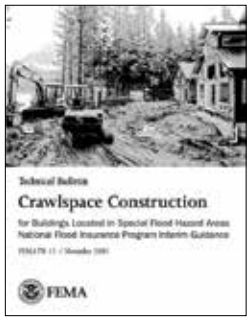
http://www.fema.gov/media-library/assets/documents/3514

FIA-TB-10 – *Ensuring That Structures Built on Fill In or Near Special Flood Hazard Areas Are Reasonably Safe From Flooding* (May 2001)

This Technical Bulletin discusses building techniques, including the use of fill that can be used to ensure structures are reasonably safe from flooding.

http://www.fema.gov/media-library/assets/documents/3522

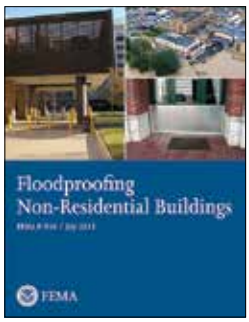
FIA-TB-11 –Technical Bulletin 11 – *Crawlspace Construction for Buildings Located in Special Flood Hazard Areas* (November 2001)



This Technical Bulletin provides interim guidance on minimum NFIP requirements as well as best practices for crawlspace construction in Special Flood Hazard Areas.

http://www.fema.gov/media-library/assets/documents/3527

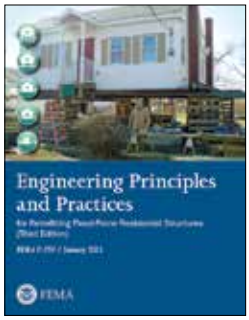
Existing Construction



FEMA P-936 – *Floodproofing Non-Residential Buildings* (July 2013)

The primary focus of this guidance document is on dry floodproofing technologies for non-residential buildings, but it also includes an overview of other techniques including wet floodproofing and the use of levees and floodwalls. The publication provides information about regulatory requirements, design considerations, and descriptions of floodproofing methods and equipment. Key document features include: 1) Tools to assist the designer or building owner in determining the best floodproofing option for a particular building including a vulnerability checklist, 2) Case studies providing examples of applied floodproofing techniques, 3) Equations for determining flood forces and loads, 4) A summary of results from recent dry floodproofing research and testing for new construction.

https://www.fema.gov/media-library/assets/documents/34270



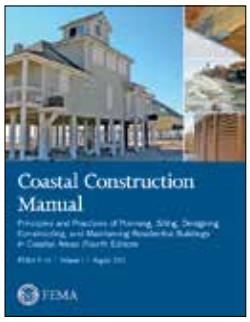
FEMA P-259 – *Engineering Principles and Practices for Retrofitting Flood-Prone Residential Structures* (Third Edition, January 2012)

The third edition of this publication is intended to aid homeowners in selecting and successfully executing a flood retrofit on their home. Engineering design and economic guidance on what constitutes feasible and cost-effective retrofitting measures for flood-prone residential and non-residential structures are presented. Elevation, relocation, dry floodproofing, wet floodproofing, and the use of levees and floodwalls to mitigate flood hazards are discussed. This edition was updated to be more user-friendly and concise, and the overall length of the publication has been shortened. New and updated graphics, as well as newly updated design calculation examples and case studies, are presented. Equations, example calculations, and the guidance in the text have been updated to reflect the most current editions of building codes and standards.

http://www.fema.gov/media-library/assets/documents/3001

New Construction

FEMA P-55 – *Coastal Construction Manual: Principles and Practices of Planning, Siting, Designing, Constructing, and Maintaining Residential Buildings in Coastal Areas* (Fourth Edition, August 2011)

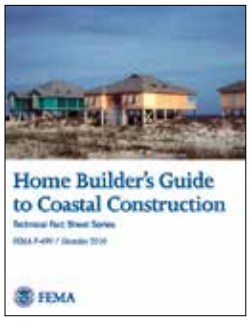


The 2011 *Coastal Construction Manual*, Fourth Edition, is a two-volume publication that provides a comprehensive approach to planning, siting, designing, constructing, and maintaining homes in the coastal environment. Volume I provides information about hazard identification, siting decisions, regulatory requirements, economic implications, and risk management. The primary audience for Volume I is design professionals, officials, and those involved in the decision-making process.

Volume II contains in-depth descriptions of design, construction, and maintenance practices that, when followed, will increase the durability of residential buildings in the harsh coastal environment and reduce economic losses associated with coastal natural disasters. The primary audience for Volume II is the design professional who is familiar with building codes and standards and has a basic understanding of engineering principles.

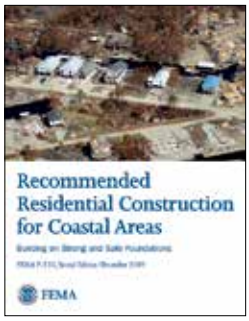
http://www.fema.gov/media-library/assets/documents/3293

FEMA P-499 – *Home Builder's Guide to Coastal Construction Technical Fact Sheet Series* (December 2010)



This publication contains a series of 37 fact sheets that provide technical guidance and recommendations concerning the construction of coastal residential buildings. The fact sheets present information aimed at improving the performance of buildings subject to flood and wind forces in coastal environments. The fact sheets make extensive use of photographs and drawings to illustrate NFIP regulatory requirements, the proper siting of coastal buildings, and recommended design and construction practices for building components, including structural connections, the building envelope, utilities, and accessory structures. Many of the fact sheets also include lists of additional resources that provide more information about the topics discussed. Where appropriate, resources are accompanied by active web links. The fact sheets are divided into nine categories: General, Planning, Foundations, Load Paths, Wall Systems, Openings, Roofing, Attachments, and Repairs. A guide, including References and Resources, is also included.

http://www.fema.gov/media-library/assets/documents/6131

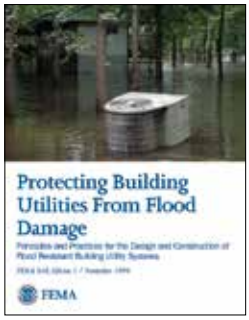


FEMA P-550 – *Recommended Residential Construction in Coastal Areas: Building on Strong and Safe Foundations* (Second Edition, December 2009)

This design manual provides recommended designs and guidance for re-building homes destroyed by hurricanes in coastal areas. The manual also provides guidance in designing and building less vulnerable new homes that reduce the risk to life and property. Construction plans and specifications in AutoCad format are also available.

http://www.fema.gov/media-library/assets/documents/3972

Nonstructural Components



FEMA P-348 – *Protecting Building Utilities From Flood Damage: Principles and Practices for the Design and Construction of Flood Resistant Building Utility Systems* (November 1999)

The overall objective of this publication is to assist in the construction of buildings with building utility systems that are designed and built so that the buildings can be re-occupied and fully operational as soon as electricity, sewer, and water are restored to the neighborhood.

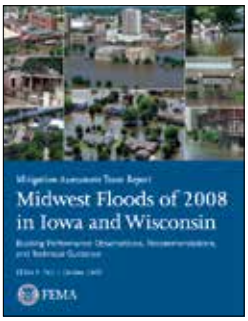
The intended users of this manual are developers, architects, engineers, builders, code officials, and homeowners who are involved in designing and constructing building utility systems for residential and non-residential structures. This manual discusses flood protective design and construction of utility systems for new buildings and modifications to utility systems in existing buildings

http://www.fema.gov/media-library/assets/documents/3729

MITIGATION ASSESSMENT TEAM REPORTS

In response to disasters, FEMA assembles a team of national experts from the design and construction industry, as well as from FEMA Headquarters and Regional Offices. This group is known as a Mitigation Assessment Team (MAT; formerly known as a Building Performance Assessment Team [BPAT]) and comprises structural, wind, and civil engineers; architects; coastal scientists; building code experts; and flood preservation specialists, as well as representatives from other government agencies, laboratories, associations, and universities. The MAT evaluates and assesses damage from hurricanes and other natural disasters, and provides observations, conclusions, and recommendations on the performance of buildings and other structures impacted by wind and flood forces. The conclusions and recommendations of the MAT reports provide decision-makers with information and technical guidance that can be used to reduce future damage from natural disasters. MAT reports for hurricanes include information on the flood hazard. A detailed listing of hurricane MAT reports can be found in this catalog under "High Wind – Mitigation Assessment Team Reports" on page 71.

FEMA P-765 – Mitigation Assessment Team Report – *Midwest Floods of 2008 in Iowa and Wisconsin: Building Performance Observations, Recommendations, and Technical Guidance* (October 2009)



In August and September 2008, the MAT deployed to the States of Iowa and Wisconsin to assess damage caused by riverine flooding from the 2008 Midwest floods. This report presents the MAT's observations on the success and failure of buildings impacted by these floods. Several examples of mitigation success stories were noted, as well lessons learned and recommendations resulting from field investigations. The report includes recovery advisories related to supporting homeowners making fundamental decisions relative to rebuilding as well as offering proactive methods to support the continuity of operations for critical facilities.

http://www.fema.gov/media-library/assets/documents/17329

2008 Midwest Floods Recovery Advisories (October 2009)

The MAT report for the Midwest Floods in Iowa and Wisconsin (FEMA P-765) contains two flood recovery advisories on considerations for rebuilding a flood-damaged house and design considerations for improving critical facility functionality during flood events.

http://www.fema.gov/media-library/assets/documents/17099

HIGH WIND PUBLICATIONS

Additional publications that include wind mitigation in coastal construction are listed under "Flood Publications" starting on page 41.

INDIVIDUALS & HOMEOWNERS

Protecting Property

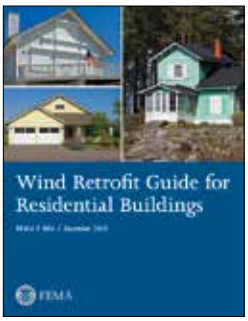
Protect Your Property From High Winds (April 2011)

These eight publications offer information on how protecting your property from high winds can involve a variety of actions, from inspecting and maintaining your building to installing protective devices. Most of these actions, especially those that affect the exterior shell of your building, should be carried out by qualified maintenance staff or professional contractors licensed to work in your state, county, or city. For buildings with Exterior Insulation Finishing System (EIFS) walls, a type of wall often used for commercial buildings, one example of wind protection is inspecting and maintaining the walls.

1. *Protect Windows and Doors with Covers*
2. *Reinforce or Replace Garage Doors*
3. *Brace Gable End Roof Framing*
4. *Secure Composition Shingle Roofs*
5. *Secure Built-Up and Single-Ply Roofs*
6. *Secure Metal Siding and Metal Roofs*
7. *Remove Trees and Potential Windborne Missiles*
8. *Maintain EIFS Walls*

https://www.fema.gov/media-library/assets/documents/13270

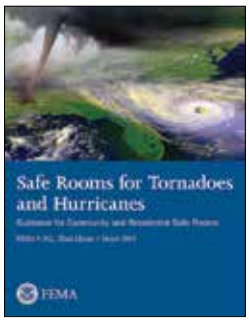
FEMA P-804 – *Wind Retrofit Guide for Residential Buildings* (December 2010)



This publication provides guidance on how to improve the wind resistance of existing residential buildings in the hurricane-prone regions throughout the United States. Wind-related damage can be reduced or prevented by improving the performance of residential buildings in these areas. Retrofitting a home is most effective when building components are strengthened in groups, or packages, to achieve a more complete improvement to the performance of the building. This guide proposes three "Mitigation Packages" retrofits – Basic, Intermediate, and Advanced. Components of each mitigation package are presented in the guide. The improvements of each package build on the retrofits of the previous package to provide increasing levels of wind hazard resistance.

http://www.fema.gov/media-library/assets/documents/21082

Safe Rooms



FEMA P-361 – *Safe Rooms for Tornadoes and Hurricanes: Guidance for Community and Residential Safe Rooms* (Third Edition, March 2015)

This publication presents important information about the design and construction of community and residential safe rooms that will provide protection during tornado and hurricane events.

The third edition of FEMA P-361 presents updated and refined criteria for safe rooms compared to the second edition's 2008 criteria. This edition also features clarified guidance and revised commentary to reflect 6 more years of post-damage assessments and lessons learned, including those based on many safe rooms directly impacted by tornadoes.

https://www.fema.gov/media-library/assets/documents/3140

Residential Safe Room Fact Sheet (February 2015)

This fact sheet provides information about residential safe rooms and explains that a safe room is a room or structure specifically designed and constructed to resist wind pressures and wind-borne debris impacts during an extreme-wind event, like tornadoes and hurricanes, for the purpose of providing life-safety protection.

http://www.fema.gov/media-library/assets/documents/23116

Flood Hazard Elevation and Siting Criteria for Residential Safe Rooms (February 2015)

This quick guide provides information on and includes illustrations of flood hazard elevation and siting criteria for residential safe rooms, based on criteria from FEMA P-361 and FEMA P-320.

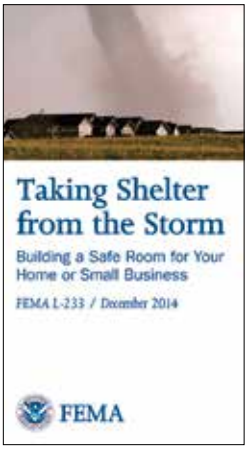
http://www.fema.gov/media-library/assets/documents/101967

FEMA P-320 – *Taking Shelter from the Storm: Building a Safe Room for Your Home or Small Business* (Fourth Edition, December 2014)

Having a safe room built for your home or small business can help provide near-absolute protection for you and your family or employees from injury or death caused by the dangerous forces of extreme winds such as tornadoes and hurricanes. *Taking Shelter from the Storm, Building a Safe Room for Your Home or Small Business*, FEMA P-320, now in its fourth edition, helps home or small business owners assess their risk and determine the best type of safe room for their needs. FEMA P-320 includes safe room designs and shows you and your builder/contractor or local design professional how to construct a safe room for your home or small business. Design options include safe rooms located inside or outside of a new home or small business.

http://www.fema.gov/media-library/assets/documents/2009

FEMA L-233 – *Taking Shelter from the Storm: Building a Safe Room for Your Home or Small Business* (December 2014)



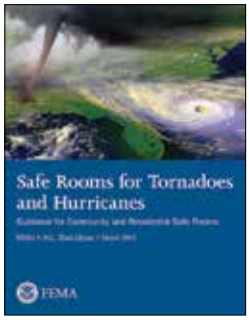
This brochure is about FEMA P-320, *Taking Shelter from the Storm, Building a Safe Room for Your Home or Small Business*, which is now in its fourth edition. It describes briefly how having a safe room built for your home or small business can help provide near-absolute protection for you and your family or employees from injury or death caused by the dangerous forces of extreme-winds such as tornadoes and hurricanes.

http://www.fema.gov/media-library/assets/documents/14951

Residential Safe Room Doors Fact Sheet (September 2014)

Residential safe rooms are becoming more popular as families seek protection from violent tornadoes. Like any other room, safe rooms must be accessed through an opening or door. Just as the walls and roof of a safe room are designed and built to protect against extreme winds and wind-borne debris, so must the safe room door. When careful selection and installation of the safe room door assembly is overlooked, the safe room door opening can leave occupants at great risk of injury or death during tornadoes.

https://www.fema.gov/media-library/assets/documents/99139



FEMA P-361 – *Safe Rooms for Tornadoes and Hurricanes: Guidance for Community and Residential Safe Rooms* (Third Edition, March 2015)

This publication presents important information about the design and construction of community and residential safe rooms that will provide protection during tornado and hurricane events.

The third edition of FEMA P-361 presents updated and refined criteria for safe rooms compared to the second edition's 2008 criteria. This edition also features clarified guidance and revised commentary to reflect 6 more years of post-damage assessments and lessons learned, including those based on many safe rooms directly impacted by tornadoes.

https://www.fema.gov/media-library/assets/documents/3140

Protect Your Property From High Winds (April 2011)

These eight publications offer information on how protecting your property from high winds can involve a variety of actions, from inspecting and maintaining your building to installing protective devices. A more detailed listing of each item in this series can be found in this catalog under "Individuals and Homeowners – Protecting Property" on page 63.

https://www.fema.gov/media-library/assets/documents/13270

COMMUNITY PLANNING & POLICY

Design and Construction Guidance

FEMA P-388-CD – *Safe Room Resources CD* (March 2015)

This CD contains displays, posters, handouts, multimedia, and other resources that provide information about mitigating for tornadoes or other high-wind events and the importance of safe rooms in saving lives during such events.

http://www.fema.gov/media-library/assets/documents/23315

FEMA L-780 – *Building Science for Disaster-Resistant Communities: Wind Hazard Publications* (March 2015)

This brochure provides readers with a quick summary of publications that will help them prepare for and mitigate against wind hazards. It describes how severe wind storms often directly damage roofs, windows, and exterior finishes. The impact that wind has on the envelope of a building can also impact the superstructure of the building, and breaches in a building envelope frequently contribute to additional damages. Debris such as signs, roofing material, and other small items can also become flying missiles during wind events, which can pose a danger to a home or the safety of its occupants.

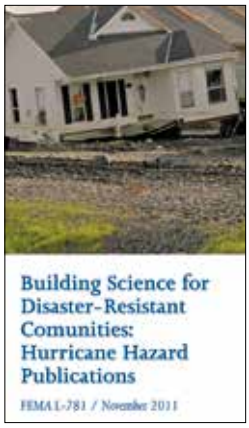
Proper design and construction provides resilient buildings that resist damages from hurricane-force winds and other high-wind events.

http://www.fema.gov/media-library/assets/documents/21150

Community Safe Room Fact Sheet (February 2015)

This fact sheet provides information about safe rooms and explains that a safe room is a room or structure specifically designed and constructed to resist wind pressures and wind-borne debris impacts during an extreme-wind event, like tornadoes and hurricanes, for the purpose of providing life-safety protection.

http://www.fema.gov/media-library/assets/documents/23112



FEMA L-781 – *Building Science for Disaster-Resistant Communities: Hurricane Hazard Publications* (November 2011)

This brochure provides readers with a quick summary of publications that will help them prepare for and mitigate against hurricane wind hazards. During a hurricane, homes, businesses, public buildings, and infrastructure may be damaged or destroyed by many different storm hazards. Debris can break windows and doors, allowing high winds and rain inside the home. In extreme storms (such as Hurricanes Hugo, Andrew, and Katrina), the force of the wind alone can cause tremendous devastation, as trees and power lines topple and weak elements of homes and buildings fail. Roads and bridges can be washed away and homes saturated by flooding.

Hurricanes pose a particular hazard to buildings, and proper design and construction are essential to help buildings withstand the impact of these storms.

http://www.fema.gov/media-library/assets/documents/21145

Hurricane Mitigation: A Handbook for Public Facilities (May 2005)

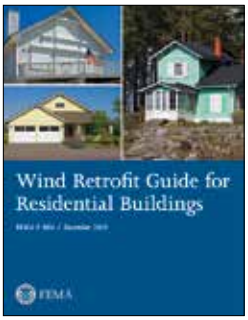
This handbook is intended to aid local jurisdictions in identifying a variety of feasible mitigation measures that can be implemented during the rebuilding process. It focuses on projects commonly eligible for hazard mitigation funding under the PA Program.

http://www.fema.gov/media-library/assets/documents/16562

BUILDING PROFESSIONALS & ENGINEERS

Existing Construction

FEMA P-804 – *Wind Retrofit Guide for Residential Buildings* (December 2010)



This publication provides guidance on how to improve the wind resistance of existing residential buildings in the hurricane-prone regions throughout the United States. Wind-related damage can be reduced or prevented by improving the performance of residential buildings in these areas. Retrofitting a home is most effective when building components are strengthened in groups, or packages, to achieve a more complete improvement to the performance of the building. This guide proposes three "Mitigation Packages" retrofits – Basic, Intermediate, and Advanced. Components of each mitigation package are presented in the guide. The improvements of each package build on the retrofits of the previous package to provide increasing levels of wind hazard resistance.

http://www.fema.gov/media-library/assets/documents/21082

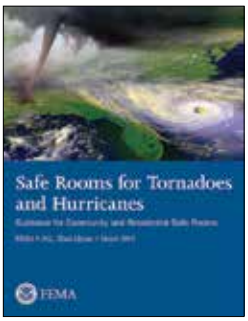
FEMA P-431 – *Tornado Protection: Selecting Refuge Areas in Buildings* (Second Edition, October 2009)

This booklet presents information (e.g., tornado profiles, effects of high winds, case studies, selection procedures, etc.) that will aid qualified architects and engineers in the identification of the best available refuge areas in existing buildings.

http://www.fema.gov/media-library/assets/documents/2246

Safe Rooms

FEMA P-361 – *Safe Rooms for Tornadoes and Hurricanes: Guidance for Community and Residential Safe Rooms* (Third Edition, March 2015)



This publication presents important information about the design and construction of community and residential safe rooms that will provide protection during tornado and hurricane events.

The third edition of FEMA P-361 presents updated and refined criteria for safe rooms compared to the second edition's 2008 criteria. This edition also

features clarified guidance and revised commentary to reflect 6 more years of post-damage assessments and lessons learned, including those based on many safe rooms directly impacted by tornadoes.

https://www.fema.gov/media-library/assets/documents/3140

Flood Hazard Elevation and Siting Criteria for Community Safe Rooms (February 2015)

This quick guide provides information on and includes illustrations of flood hazard elevation and siting criteria for community safe rooms, based on criteria from FEMA P-361.

http://www.fema.gov/media-library/assets/documents/101965

Flood Hazard Elevation and Siting Criteria for Residential Safe Rooms (February 2015)

This quick guide provides information on and includes illustrations of flood hazard elevation and siting criteria for residential safe rooms, based on criteria from FEMA P-361 and FEMA P-320.

http://www.fema.gov/media-library/assets/documents/101967

FEMA P-320 – *Taking Shelter from the Storm: Building a Safe Room for Your Home or Small Business* (Fourth Edition, December 2014)

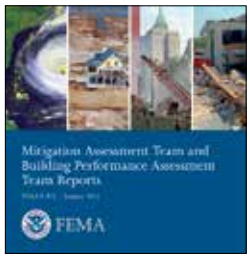
Having a safe room built for your home or small business can help provide near-absolute protection for you and your family or employees from injury or death caused by the dangerous forces of extreme winds such as tornadoes and hurricanes. *Taking Shelter from the Storm, Building a Safe Room for Your Home or Small Business*, FEMA P-320, now in its fourth edition, helps home or small business owners assess their risk and determine the best type of safe room for their needs. FEMA P-320 includes safe room designs and shows you and your builder/contractor or local design professional how to construct a safe room for your home or small business. Design options include safe rooms located inside or outside of a new home or small business.

http://www.fema.gov/media-library/assets/documents/2009

MITIGATION ASSESSMENT TEAM REPORTS

In response to disasters, FEMA assembles a team of national experts from the design and construction industry, as well as from FEMA Headquarters and Regional Offices. This group is known as a Mitigation Assessment Team (MAT; formerly known as a Building Performance Assessment Team [BPAT]) and comprises structural, wind, and civil engineers; architects; coastal scientists; building code experts; and flood preservation specialists, as well as representatives from other government agencies, laboratories, associations, and universities. The MAT evaluates and assesses damage from hurricanes and other natural disasters, and provides observations, conclusions, and recommendations on the performance of buildings and other structures impacted by wind and flood forces. The conclusions and recommendations of the MAT reports provide decision-makers with information and technical guidance that can be used to reduce future damage from natural disasters.

FEMA P-905 DVD – *Mitigation Assessment Team and Building Performance Assessment Team Reports* (January 2014)



This interactive DVD includes reports, recovery advisories, and PowerPoint presentations for FEMA MATs and BPATs from Hurricane Andrew to Hurricane Sandy.

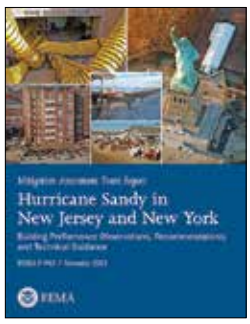
http://www.fema.gov/media-library/assets/documents/101073

FEMA P-1020 – Formal Observation Report – *Tornado: Moore, Oklahoma, May 20, 2013* (August 2014)

This formal observation report presents the observations, conclusions, and recommendations in response to field investigations conducted after the EF-5 tornado that impacted Moore, Oklahoma, on May 20, 2013. The post-storm investigation team focused its efforts on safe rooms and storm shelters in the path of the tornado in order to analyze their performance, functionality, and use.

https://www.fema.gov/media-library/assets/documents/100807

FEMA P-942 – *Mitigation Assessment Team Report: Hurricane Sandy in New Jersey and New York* (November 2013)



FEMA P-942 documents observations made during field visits conducted by the MAT following Hurricane Sandy, specifically deployed to evaluate key building damages. FEMA P-942 presents the conclusions and recommendations derived from the field observations with regards to key engineering concepts, codes and standards, mitigation measures and considerations that can be used in the planning and recovery process to help minimize future damage to structures and their related utility systems. The recommenda-

tions for disaster-resistant practices in hurricane-prone regions presented are applicable to planners; decision makers; designers; contractors; building officials; Federal, State, and local government officials; building owners and operators; emergency managers; and homeowners. Observations, conclusions, and recommendations related to building codes and standards; flood protective measures; residential construction; critical facilities and key assets; and mechanical, electrical, and plumbing systems are included.

http://www.fema.gov/media-library/assets/documents/85922

Hurricane Sandy Recovery Advisories and Fact Sheets (2013, 2014)

Seven Recovery Advisories (RAs) were developed by the MAT studying the damage of Hurricane Sandy. They offer mitigation measures that could be taken to minimize damage to buildings. A list of the RAs can be seen below.

RA 1 – *Improving Connections in Elevated Coastal Residential Buildings*

RA 2 – *Reducing Flood Effects in Critical Facilities*

RA 3 – *Restoring Mechanical, Electrical, and Plumbing Systems In Non-Substantially Damaged Residential Buildings*

RA 4 – *Reducing Interruptions to Mid- and High-Rise Buildings During Floods*

RA 5 – *Designing for Flood Levels Above the BFE After Hurricane Sandy*

RA 6 – *Protecting Building Fuel Systems from Flood Damage*

RA 7 – *Reducing Flood Risk and Flood Insurance Premiums for Existing Residential Buildings in Zone A*

https://www.fema.gov/media-library/assets/documents/30966

Fact Sheet 1 – *Cleaning Flooded Buildings*
https://www.fema.gov/media-library/assets/documents/31368

Fact Sheet 2 – *Foundation Requirements and Recommendations for Elevated Homes*
https://www.fema.gov/media-library/assets/documents/32506

Fact Sheet 3 – *Building Science Support and Code Changes Aiding Sandy Recovery*
https://www.fema.gov/media-library/assets/documents/100138

FEMA P-938 – *Mitigation Assessment Team Report – Hurricane Isaac in Louisiana: Building Performance Observations Recommendations, and Technical Guidance* (March 2013)

In response to Hurricane Isaac, the FEMA deployed a MAT to evaluate and assess damage from the hurricane and provide observations, conclusions, and recommendations on the performance of buildings and other structures impacted by wind and flood forces. The MAT included representatives from FEMA Headquarters and other Federal agencies, local government officials, academia, and experts from the design and construction industry. The con-

clusions and recommendations of this report are intended to provide decision-makers with information and technical guidance that can be used to reduce future hurricane damage.

http://www.fema.gov/media-library/assets/documents/31386

Hurricane Isaac Recovery Advisories (2012)

These two Recovery Advisories were developed by the MAT studying the damage of Hurricane Isaac. They offer mitigation measures that could be taken to minimize damage to buildings.

RA 1 – *Minimizing Wind and Water Intrusion by Covering the Underside of Elevated Buildings*

RA 2 – *Minimizing Flood Damage to Electrical Service Components*

http://www.fema.gov/media-library/assets/documents/29930

FEMA P-908 – Mitigation Assessment Team Report – *Spring 2011 Tornadoes: April 25-28 and May 22* (May 2012)

In May and June 2011, MATs were deployed to Alabama, Georgia, Mississippi, Tennessee, and Missouri, respectively, to assess the damage caused by outbreaks of tornadoes in those states. This report presents the MATs observations, conclusions, and recommendations in response to those field investigations. The mission of the MATs was to assess the performance of structures affected by the tornadoes, investigate safe room and shelter performance in the affected areas, and describe the lessons learned to help future efforts to more successfully mitigate tornado events. The objective of the report is to provide information to communities, businesses, and individuals so that they can rebuild safer, more robust structures and minimize loss of life, injuries, and property damage in future tornadoes and high-wind events. The MAT report presents the observations, conclusions, and recommendations for residential structures, as well as commercial and other non-residential and critical facilities (e.g., schools, hospitals and health care facilities, first responder facilities, and emergency operations centers and emergency management agencies).

http://www.fema.gov/media-library/assets/documents/25810

2011 Tornadoes in Alabama, Georgia, Mississippi, Tennessee, and Missouri Recovery Advisories

These eight recovery advisories present guidance on tornado risks and hazards in the Southeastern United States; selecting design criteria for safe rooms; residential sheltering (in-residence and stand-alone safe rooms); safe rooms and refuge areas in a home; recommendations for owners of critical facilities located in tornado-prone regions; recommendations for architects and engineers for critical facilities located in tornado-prone regions; rebuild-

ing and repairing a home after a tornado; and reconstructing non-residential buildings after a tornado.

http://www.fema.gov/media-library/assets/documents/22024

FEMA P-757 – *Mitigation Assessment Team Report – Hurricane Ike in Texas and Louisiana: Building Performance Observations, Recommendations, and Technical Guidance* (April 2009)

Hurricane Ike was the ninth named storm during the 2008 hurricane season and the seventh of the season's storms to hit the U.S. mainland. Hurricane Ike is likely to be one of the costliest and most destructive hurricanes in U.S. history; the total damage was estimated to be $21.3 billion dollars, making it the fourth costliest hurricane in history behind Hurricanes Katrina (2005), Andrew (1992), and Wilma (2005). The MAT report focuses on damage to critical facilities and residential construction for both flood and wind. A special section focuses on damage to high-rise buildings in downtown Houston. Recommendations focus on actions that should be taken as part of the rebuilding efforts in Texas and Louisiana.

http://www.fema.gov/media-library/assets/documents/15498

Hurricane Ike Recovery Advisories (2009)

The MAT report for Hurricane Ike (FEMA P-757) contains eight hurricane recovery advisories on attachment of brick veneer in high-wind regions; design and construction in Coastal A Zones; designing for flood levels above the BFE; enclosures and breakaway walls; erosion, scour, and foundation design; metal roof systems in high-wind regions; minimizing water intrusion through roof vents in high-wind regions; and siding installation in high-wind regions.

http://www.fema.gov/media-library/assets/documents/15100

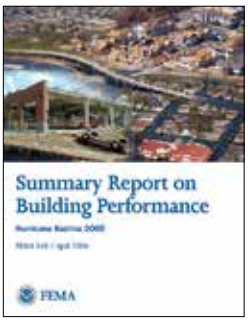
FEMA 549 – *Mitigation Assessment Team Report – Hurricane Katrina in the Gulf Coast: Building Performance Observations, Recommendations, and Technical Guidance* (July 2006)

Hurricane Katrina was one of the strongest and most destructive storms to hit the Gulf Coast of the United States in the last 100 years. Katrina significantly exceeded the base flood elevations (BFEs) by as much as 15 feet along parts of the Louisiana and Mississippi coasts. Flooding extended well beyond the inland flood limits of the SHFA, and the highest storm surge in U.S. his-

tory was recorded along the Mississippi coast. The American Red Cross estimated that Katrina destroyed over 300,000 single-family homes in Louisiana and Mississippi.

https://www.fema.gov/media-library/assets/documents/4069

FEMA 548 – *Summary Report on Building Performance: Hurricane Katrina 2005* (April 2006)



This is an 80-page summary of the almost 700-page FEMA 549 MAT report.

https://www.fema.gov/media-library/assets/documents/1054

Hurricane Katrina Recovery Advisories (2005)

The MAT report for Hurricane Katrina (FEMA 549) contains eight hurricane recovery advisories on: reconstruction guidance using Hurricane Katrina surge inundation and Advisory BFEs; initial restoration for flooded buildings; design and construction in Coastal A Zones; the ABCs of returning to flooded buildings; attachment of brick veneer in high-wind regions; attachment of rooftop equipment in high-wind regions; rooftop attachment of lightning protection systems in high-wind regions; and designing for flood levels above the BFE.

http://www.fema.gov/media-library/assets/documents/9968

FEMA 489 – *Mitigation Assessment Team Report – Hurricane Ivan in Alabama and Florida: Observations, Recommendations, and Technical Guidance* (August 2005)

Hurricane Ivan approximated a design flood event on the barrier islands and exceeded design flood conditions in sound and back bay areas. This provided a good opportunity to assess the adequacy of NFIP floodplain management requirements as well as current construction practices in resisting storm surge and wave damage. FEMA was particularly interested in evaluating damage to buildings in Coastal A Zones where Zone V construction methods are not required.

http://www.fema.gov/media-library/assets/documents/2338

Hurricane Ivan Recovery Advisories (2004)

These four hurricane recovery advisories are part of the MAT report for Hurricane Ivan (2004) in Alabama and Florida (FEMA 489), and cover the following topics: roof underlayment for asphalt shingle roofs; asphalt shingle roofing for high-wind regions; tile roofing for hurricane-prone areas; and coastal building successes and failures.

http://www.fema.gov/media-library/assets/documents/9987

FEMA 488 – *Mitigation Assessment Team Report – Hurricane Charley in Florida: Observations, Recommendations, and Technical Guidance* (April 2005)

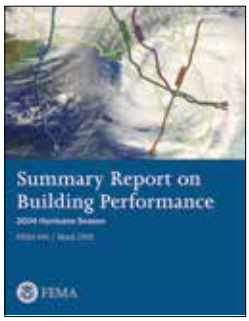
Hurricane Charley was the strongest hurricane to hit Florida since Hurricane Andrew. The storm made an unexpected eastward turn prior to landfall and the storm surge was not as high as originally predicted by the National Hurricane Center. Charley did not cause extensive flood damage to the built environment and the MAT's investigations revealed that the storm was a design-level wind event. For these reasons, the report primarily addresses the effects of high winds and the means to help mitigate them.

http://www.fema.gov/media-library/assets/documents/905

Hurricane Charley (2004) Recovery Advisories

The MAT report for Hurricane Charley (FEMA 488) contains three hurricane recovery advisories on roof underlayment for asphalt shingle roofs; asphalt shingle roofing for high-wind regions; and tile roofing for hurricane-prone areas.

http://www.fema.gov/media-library/assets/documents/9959



FEMA 490 – *Summary Report on Building Performance 2004 Hurricane Season* (March 2005)

This is a 68-page summary of the observation, conclusions, and recommendations from FEMA 488 and FEMA 489.

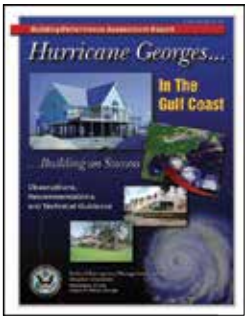
http://www.fema.gov/media-library/assets/documents/943

FEMA 342 – Building Performance Assessment Team Report – *Midwest Tornadoes of May 3, 1999: Observations, Recommendations, and Technical Guidance* (October 1999)

On the evening of May 3, 1999, tornadoes tore through parts of Oklahoma and Kansas, in areas that are considered part of "Tornado Alley," leveling entire neighborhoods and killing 49 people. The storms that spawned the tornadoes moved slowly, contributing to the development and redevelopment of individual tornadoes over an extended period of time. The report presents observations, conclusions, and recommendations intended to help communities, businesses, and individuals reduce future injuries and the loss of life and property resulting from tornadoes and other high-wind events.

http://www.fema.gov/media-library/assets/documents/647

FEMA 338 – Building Performance Assessment Team Report – *Hurricane Georges in the Gulf Coast: Building Performance Observations, Recommendations, and Technical Guidance* (March 1999)



Hurricane Georges made landfall in the Ocean Springs/Biloxi, Mississippi area. Over the next 30 hours, the storm moved slowly north and east, causing heavy damage along the Gulf Coast in Alabama, Florida, and Mississippi. Storm surges over the area ranged from more than five feet in Pensacola, Florida, to 9 feet in Pascagoula, Mississippi. According to the National Weather Service (NWS), the Town of Munson, Florida, in Santa Rosa County, received the highest recorded level of rainfall with more than 38 inches.

http://www.fema.gov/media-library/assets/documents/2070

FEMA 339 – Building Performance Assessment Team Report – *Hurricane Georges in Puerto Rico: Building Performance Observations, Recommendations, and Technical Guidance* (March 1999)

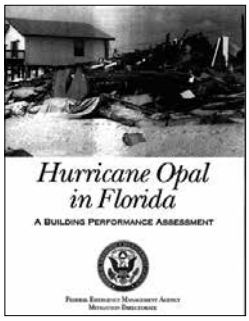
This publication presents observations on the success and failure of buildings in Puerto Rico in withstanding the wind and flood forces generated by Hurricane Georges. Several examples of successful mitigation implementation were noted, but a significant amount of damage was incurred due to lack of compliance with and enforcement of existing building codes.

http://www.fema.gov/media-library/assets/documents/615

FEMA 290 – *Building Performance Assessment Team Report – Hurricane Fran in North Carolina: Building Performance Observations, Recommendations, and Technical Guidance* (March 1997)

Hurricane Fran made landfall near Cape Fear, North Carolina. Coastal areas experienced significant erosion and scour. Erosion caused by Hurricane Fran was exacerbated by the previous dune erosion caused by Hurricane Bertha, which made landfall in the same area only two months earlier. The erosion and scour added to the average erosion rate of one to two feet a year and left many oceanfront homes unable to withstand the loads experienced. The loss of supporting sand left many short pilings either completely exposed or embedded less than two feet.

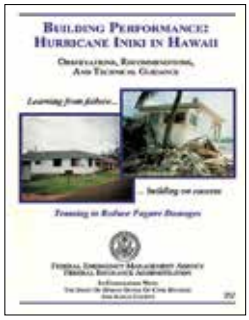
http://www.fema.gov/media-library/assets/documents/10893



FEMA 281 – Building Performance Assessment Team Report – *Hurricane Opal in Florida* (August 1996)

Hurricane Opal was classified as a Category three storm on the Saffir-Simpson scale. Fifteen counties in the Florida Panhandle were declared Federal disaster areas. Most of the structural damage associated with the storm was to slab foundations; pile, post, column, and pier foundations; and framing systems. The damage was caused by coastal flood forces – storm surge, wind-generated waves, storm-induced erosion, and floodborne debris.

http://www.fema.gov/media-library/assets/documents/10874



FIA 23 – Building Performance Assessment Report – *Hurricane Iniki in Hawaii: Observations, Recommendations, and Technical Guidance* (March 1993)

Hurricane Iniki was the strongest and most destructive hurricane to strike the Hawaiian Islands in recent memory. The team investigated primary structural systems (i.e., systems in a building that resist lateral and vertical forces), and the effects of windborne and waterborne debris and the quality of construction and materials. The performance of exterior architectural systems (such as roofing, windows, and doors) was analyzed.

http://www.fema.gov/media-library/assets/documents/10850

FIA 22 – Building Performance Assessment Report – *Hurricane Andrew in Florida: Observations, Recommendations, and Technical Guidance* (February 1993)

The team's investigation was similar to that conducted for Hurricane Iniki (i.e., the performance of primary structural systems and exterior architectural systems) and also included the effects of debris and the quality of construction workmanship. The loss of roof material and roof sheathing and the failure of windows and doors exposed interiors of buildings to further damage from wind and rain, resulting in significant damage to building interiors and contents that rendered many buildings uninhabitable.

http://www.fema.gov/media-library/assets/documents/10827

MULTI-HAZARD PUBLICATIONS

INDIVIDUALS & HOMEOWNERS

Protecting Property

FEMA P-940CD – *Multi-Hazard Mitigation and Design Concepts: Wind, Flood, and Earthquake Training Videos* (March 2014)

Educating disaster workforces and the people who live in at-risk communities about natural hazards and the ways to mitigate risk is an important part of the FEMA mission. FEMA P-940CD presents three videos based on webinars abridged from the FEMA training course E312, Fundamentals of Building Science – Multi-Hazard Mitigation and Design Concepts. Each video explains the hazard (earthquake, wind, and flood) and the hazard-related damage, and provides users with some common sense tools to assist with specific mitigation work. The earthquake video includes an introduction illustrated by a recent earthquake event, a discussion of the hazards that can arise from seismic events, the types of earthquake damage commonly seen in the building environment, and seismic design basics. The earthquake video also discusses how buildings resist earthquakes and the seismic design process for new and existing construction.

https://www.fema.gov/media-library/assets/documents/95935

Building Codes Toolkit for Property Owners (January 2014)

This Building Codes Toolkit provides basic guidance and easy-to-use tools to help property owners understand building codes and the basic processes and standards associated with proper design, permitting, construction, and mitigation.

https://www.fema.gov/media-library/assets/documents/30423

Emergency Preparedness

FEMA IS-22 – *Are You Ready? An In-depth Guide to Citizen Preparedness* (2004)

This guide provides citizens with step-by-step procedures on how to develop, practice, and maintain emergency plans for protecting lives and property before, during, and after a disas ter. Also included is information for individuals and their families on how to assemble a dis aster supplies kit with a sufficient quantity of food, water, and other supplies. The guide is available in Spanish and English.

http://www.fema.gov/pdf/areyouready/areyouready_full.pdf

PRIVATE SECTOR & SMALL BUSINESS

Protect Your Business From All Natural Hazards (April 2011)

These two publications describe how protecting your business from disasters caused by natural hazards can involve a variety of actions, from inspecting and maintaining your buildings to installing protective devices. Most of these actions, especially those that affect the structure of your buildings or their utility systems, should be carried out by qualified maintenance staff or professional contractors licensed to work in your state, county, or city. One example of disaster protection is safely storing the important documents, electronic files, raw materials, and inventory required for the operation of your business.

1. *Install a Generator for Emergency Power*
2. *Protect Business Records and Inventory*

https://www.fema.gov/media-library/assets/documents/13232

Risk Management Series

The Risk Management Series (RMS) is directed at providing design guidance for mitigating multihazard events. The objective of the series is to reduce physical damage to structural and nonstructural components of buildings and related infrastructure, and to reduce resultant casualties during natural and manmade disasters. More information on the RMS and for a detailed listing of multi-hazard publications in this series can be found in this catalog under "Multi-Hazard – Building Professionals and Engineers" on page 86.

COMMUNITY PLANNING & POLICY

Design and Construction Guidance

FEMA P-950 CD – *FEMA Building Science Toolkit CD* (March 2015)

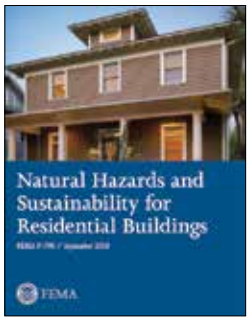
The FEMA Building Science Toolkit CD contains some of the key resources, organized by hazard, from the Building Science Library and links to additional resources.

The Building Science Toolkit CD contains:

- General information and technical guidance for State and local officials on the design and construction of hazard-resistant buildings and the retrofit of existing buildings to reduce the risk of damage from flooding and other natural hazards
- Fifty-nine of the most widely used FEMA publications including design manuals, tools for assessing damage, technical bulletins, recovery advisories, best practices, and evaluations and comparisons of building codes
- Links to additional publications on hazard resistance and design prepared by FEMA and other Federal agencies.

The resources cited on the CD can be used with flood risk maps and other Risk Mapping, Assessment, and Planning (Risk MAP) products by local officials, developers, contractors and building owners to better define areas of mitigation interest, determine flood depth and velocity data needed for building design, and determine where hydraulic analyses should be conducted to assist with siting, foundation, and structure design. Distribution of the Toolkit CD is encouraged during the Risk MAP Community Engagement and Resilience meetings between FEMA and communities.

http://www.fema.gov/media-library/assets/documents/92819



FEMA P-798 – *Natural Hazards and Sustainability for Residential Buildings* (September 2010)

This publication examines current green building rating systems in a broader context. It identifies green building practices – the tools of today's green building rating systems – that are different from historical residential building practices and that, unless implemented with an understanding of their interactions with the rest of the structure, have the potential to compromise a building's resistance to natural hazard events. This publication also discusses how to retain or improve natural hazard resistance while incorporating these green building practices. While most common green building practices provide sustainability

advantages with little or no effect on structural performance or durability, others require reevaluation of the building's structural design or detailing to retain its integrity during natural hazard events. Often, only minimal design modifications are required to maintain natural hazard resistance.

http://www.fema.gov/media-library/assets/documents/19750

BUILDING PROFESSIONALS & ENGINEERS

Risk Management Series

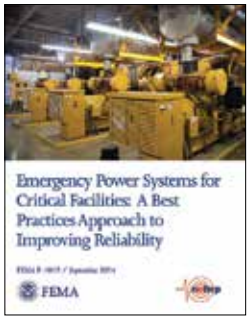
The RMS is directed at providing design guidance for mitigating multi-hazard events. The objective of the series is to reduce physical damage to structural and nonstructural components of buildings and related infrastructure, and to reduce resultant casualties during natural and manmade disasters.

The RMS is intended to minimize conflicts that may arise from a multi-hazard design approach. A multi-hazard approach requires a complex series of tradeoffs. Security concerns need to be balanced with requirements in terms of earthquakes, floods, high-speed winds, accessibility, fire protection, and aesthetics, among others. Designing to mitigate natural hazards should avoid considering manmade hazards as an afterthought, but rather as a critical concern to be studied early during the project cycle. Natural hazards are the largest single contributor to catastrophic or repetitive damage to communities nationwide. Manmade hazards can be categorized as rare events with a potential high impact and very difficult to predict.

FEMA P-907 CD – *Risk Management Series: Multi-Hazard* (April 2011)

This CD includes the RMS publications that relate to natural disasters (with publication dates through 2011).

http://www.fema.gov/media-library/assets/documents/101098

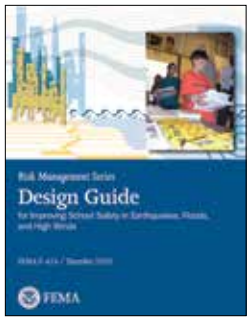


FEMA P-1019 – *Emergency Power Systems for Critical Facilities: A Best Practices Approach to Improving Reliability* (September 2014)

This publication discusses the effects of natural hazards on electrical transmission and distribution infrastructure and on building systems. It discusses how to determine what facilities are critical, what equipment within a critical facility is needed to allow the facility to function and provide services, and how to provide emergency power to a critical facility.

https://www.fema.gov/media-library/assets/documents/101996

FEMA P-424 – *Design Guide for School Safety in Earthquakes, Floods, and High Winds* (December 2010)



This manual is the updated version of the original FEMA 424 published in January 2004. It is intended to provide guidance for the protection of school buildings from natural disasters. This volume concentrates on grade schools, K-12. FEMA P-424 covers earthquakes, floods, and high winds. Its intended audience is design professionals and school officials involved in the technical and financial decisions of school construction, repair, and renovations.

http://www.fema.gov/media-library/assets/documents/5264

FEMA 577 – *Design Guide for Improving Hospital Safety in Earthquakes, Floods, and High Winds* (June 2007)

This publication provides design information for the construction of new hospitals and rehabilitation of existing ones with the purpose of improving their performance during the immediate aftermath of various hazard events. This manual is concerned with factors such as performance-based design and continuity of operations for this type of building. It provides a multihazard approach highlighting conflicts and benefits to consider when designing.

http://www.fema.gov/media-library/assets/documents/10672

FEMA 543 – *Design Guide for Improving Critical Facility Safety from Flooding and High Winds* (January 2007)

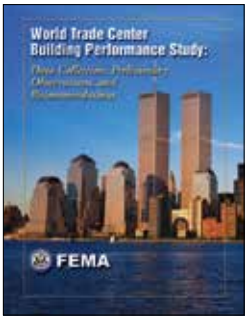
This manual concentrates on critical facilities (hospitals, schools, fire and police stations, and emergency operations centers). It is based on the behavior of critical facilities during Hurricane Katrina and makes recommendations on the performance of these types of buildings. It includes extensive information on the impact of storm surges to the Gulf area.

http://www.fema.gov/media-library/assets/documents/8811

OTHER HAZARD PUBLICATIONS

MAN-MADE

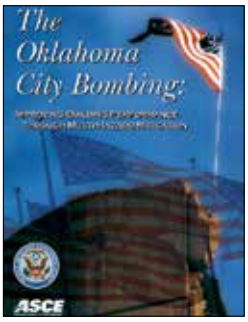
FEMA 403 – *World Trade Center Building Performance Study: Data Collection, Preliminary Observations, and Recommendations* (September 2002)



This MAT report presents observations, findings, and recommendations regarding the performance of buildings affected by the September 11 attacks on the World Trade Center towers in New York City. The report also describes the structural and fire protection features of the affected buildings and their performance in response to the terrorist attacks.

http://www.fema.gov/media-library/assets/documents/3544

FEMA 277 – *The Oklahoma City Bombing: Improving Building Performance Through Multi-Hazard Mitigation* (August 1996)



The purposes of the MAT investigation were to review damage caused by the blast, determine the failure mechanism for the building, and review engineering strategies for reducing such damage to new and existing buildings in the future. Specifically, mechanisms for multi-hazard mitigation, including mitigation of wind and earthquakes effects, were considered.

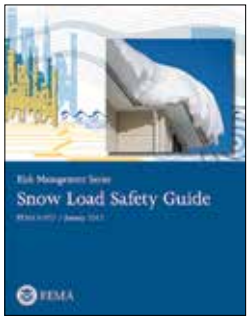
https://www.fema.gov/media-library/assets/documents/1967

SNOW

FEMA Snow Load Safety Guidance Fact Sheet (February 2013)

This flyer summarizes warning signs of overstress conditions during a snow event, key safety issues and risks a snow event poses to buildings, and what to do after a snow event.

https://www.fema.gov/media-library/assets/documents/29670



FEMA P-957 – *Snow Load Safety Guide* (January 2013)

The objective of the Risk Management Series Snow Load Safety Guide is to inform building stakeholders about the risks a snow event poses to their buildings, provide them with information about preventative measures to take before the snow season, and inform them of actions that should be taken before, during, and after a snow event. This document is not intended to provide a comprehensive discussion of the underlying issues or forensics of snow-induced structural failure. The purpose is instead to: Inform building stakeholders of susceptible snow loading conditions; Identify potentially vulnerable roof framing systems; Outline a general methodology to monitor buildings for signs of potential failure so that steps can be taken to reduce the potential risk of snow-load-induced structural failure.

https://www.fema.gov/media-library/assets/documents/83501

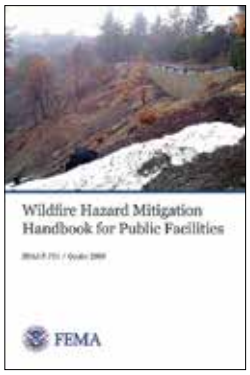
WILDFIRE

Rebuilding After a Wildfire Fact Sheet (November 2011)

Returning to your fire-damaged home will undoubtedly be an emotional experience. But as you go about the task of rebuilding, there are many ways to rebuild safer, stronger, smarter and more resilient to wildfires. FEMA has teamed with Firewise Communities, the Federal Alliance for Safe Homes, and the Insurance Institute for Business and Home Safety to provide this resource for rebuilding after a fire.

http://www.fema.gov/media-library/assets/documents/12266

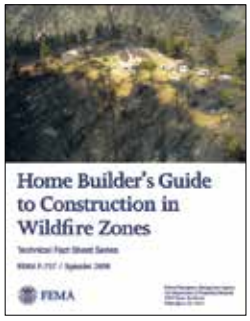
FEMA P-754 – *Wildfire Hazard Mitigation Handbook for Public Facilities* (October 2008)



This *Wildfire Hazard Mitigation Handbook for Public Facilities* is intended to assist facility owners affected by wildfire disasters by suggesting mitigation measures that can be taken to reduce the vulnerability of damaged facilities to future wildfire incidents.

http://www.fema.gov/media-library/assets/documents/16568

FEMA P-737 – *Home Builder's Guide to Construction in Wildfire Zones Technical Fact Sheet Series* (September 2008)



The purpose of this series of 17 Technical Fact Sheets is to provide information about wildfire behavior and recommendations for building design and construction methods in the wildland/urban interface. Implementation of the recommended design and construction methods can greatly increase the chances of a building's survival in a wildfire. In addition to the recommendations for building design and construction methods, other fact sheet subject areas include selecting the construction site; defensible space; roofs; eaves, overhangs, and soffits; exterior walls; vents; gutters and downspouts; windows and skylights; exterior doors; foundations; decks and other attached structures; landscape fences and walls; fire sprinklers; utilities and exterior equipment; and community infrastructure.

http://www.fema.gov/media-library/assets/documents/15962

Protect Your Property from Fire (April 2008)

Wildfire protection can involve a variety of changes to your house and property -- changes that can vary in complexity and cost. You may be able to make some types of changes yourself. But complicated or large-scale changes and those that affect the structure of your house or its electrical wiring and plumbing should be carried out only by a professional contractor licensed to work in your state, county, or city. One example of wildfire protection is removing vegetation, yard debris, and other combustible materials that may be near your house. This is something that many homeowners can probably do on their own.

1. *Dealing with Vegetation and Combustible Materials*
2. *Replace Roofing with Fire-Resistant Materials*

https://www.fema.gov/media-library/assets/documents/13256

TRAINING COURSES AND WORKSHOPS

Numerous training courses/workshops have been developed by FEMA Building Science. These courses/workshops are typically offered either in the field or in conferences. They can also be offered at FEMA's Emergency Management Institute (EMI) in Emmitsburg, Maryland.

EARTHQUAKES

Listed below are training courses offered through FEMA's NETAP. The courses are conducted by ATC, under contract to FEMA, and are designed for State and local building personnel, facilities managers, and other groups. NETAP-supported training is provided on site, with courses typically one day or less in duration, and via webinars. For more information on these earthquake training courses and assistance, see http://www.fema.gov/earthquake-training.

There are also many self-instructional training opportunities offered through the educational training tools developed by the Branch and included on CD-ROM, such as Multi-hazard Mitigation and Design Concepts: Wind, Flood, and Earthquake, Training Videos, FEMA P-940CD, March 2014. Entries in this Catalog for these resources describe the training opportunities.

FEMA 154 – *Rapid Visual Screening of Buildings for Potential Seismic Hazards*

Trainees learn how to identify potentially hazardous buildings before earthquakes occur. The course covers methods and processes that enable personnel to rapidly identify, inventory and rank local buildings according to their expected safety and usability during and after earthquakes. Local officials can use these data to plan and prioritize further engineering and vulnerability analysis, emergency-response needs, and mitigation projects. (Course length: 1 day)

FEMA 154 – *Rapid Visual Screening of Buildings for Potential Seismic Hazards and ATC-20-1 Field Manual: Postearthquake Safety Evaluation of Buildings*

The FEMA 154 course, described above, may be combined with ATC-20 training, in which students learn how to evaluate the safety of buildings following earthquakes. ATC-20 trainees learn to perform seismic inspections and safety evaluations of buildings and post appropriate safety-status placards. These evaluations and placards can be used in planning and executing evacuation, re-entry and rebuilding strategies. (Course length: 1 day)

FEMA 154 – *Rapid Visual Screening of Buildings for Potential Seismic Hazards and Rapid Observation of Vulnerability and Estimation of Risk (ROVER) Version 2*

The FEMA 154 course, described above, may be combined with ROVER Version 2 training and demonstration assistance. ROVER is open-source software that automates the paper-based screening procedures taught in the FEMA 154 course. ROVER Version 2 includes many productivity-enhancing features. The software now works on any mobile device, such as Android, iPhone, iPad, and Windows Phone, with a web browser and active data connection. ROVER Version 2 also improves photo handling and the training material and user manual have both been updated and include instructions on batch-loading a pre-existing database and on the use of the RedROVER software, which exports ROVER data to Hazus-MH's Advanced Engineering Building Module. (Course length: 6 hours)

FEMA 154 – *Rapid Visual Screening of Buildings for Potential Seismic Hazards, ATC-20, and ROVER Version 2*

The FEMA 154 course, ATC-20, and ROVER Version 2 (for all, see above) are combined in this training and demonstration course. (Course length: 2 days)

FEMA E-74 – *Reducing the Risks of Nonstructural Earthquake Damage*

This training describes the sources of nonstructural earthquake damage and effective methods of reducing such damage. Nonstructural failures have accounted for the majority of damage in several recent U.S. earthquakes. It is critical to raise awareness of potential nonstructural hazards, the costly consequences of nonstructural failures and the opportunities that exist to limit future losses. Nonstructural components of buildings include all elements that are not part of the structural system; that is, the architectural, mechanical, electrical and plumbing systems, as well as furniture, fixtures, equipment and other contents. (Course length: 1 day; Webinar: 90 minutes)

FEMA P-50 – *Simplified Seismic Assessment of Detached, Single-Family, Wood-Frame Dwellings*

Using the FEMA P-50 seismic assessment system and its accompanying retrofit guidelines, FEMA P-50-1, trainees learn how to assign a Seismic Performance Grade to detached, wood-frame residential structures; identify seismic retrofit opportunities and priorities; and identify an improved Seismic Performance Grade, if retrofit occurs. Target audiences include building owners and building officials, home inspectors, design professionals, home builders, emergency planners, insurers, and lenders. (Course length: 6 hours)

FEMA P-58 – *Seismic Performance Assessment of Buildings*

This course presents trainees with a methodology for assessing how well a building is likely to perform in an earthquake. The methodology expresses performance as the probable losses (casualties, repair costs, repair time, en-

vironmental impacts) resulting from earthquake-induced building damage. It takes into account the uncertainty that is inherent in predictions of future outcomes, and enables the sources of losses to be identified, which facilitates the refinement of building designs. Seismic performance assessments developed with this methodology will allow decision makers to more easily perform cost-benefit analyses and select appropriate performance goals for seismic design projects. (Webinar course length: 90 minutes)

FEMA 395 – *Earthquake Safety and Mitigation for Schools*

This training is for school officials, teachers, facility managers, and other stakeholders interested in reducing earthquake risks in local schools. Numerous school buildings located in multiple states and U.S. territories are vulnerable to earthquake damage that threatens safety and continued operations. Attendees learn how to assess and analyze seismic risks; how to develop actionable plans for reducing and managing these risks; how to secure nonstructural elements of school facilities; and how to use "incremental seismic rehabilitation" as an affordable approach for protecting existing buildings and ensuring occupant safety. (Course length: About 4 hours; Webinar: 90 minutes)

FEMA P-593 – *Seismic Rehabilitation Training for One- and Two-Family Wood-Frame Dwellings*

This training promotes seismic rehabilitation of one- and two-family homes to reduce earthquake damage and increase post-earthquake habitability. Trainees are introduced to the effects of earthquakes on wood-frame dwellings, common seismic vulnerabilities in these structures, rehabilitation approaches and available rehabilitation guidelines. (Course length: 6 hours)

FEMA P-646 – *Guidelines for Design of Structures for Vertical Evacuation from Tsunamis*

Vertical evacuation structures provide a means to create areas of refuge within the tsunami inundation zone for communities in which evacuation out of the zone is not feasible. This training provides guidance on the following: planning and design of tsunami vertical evacuation structures: the tsunami hazard and its history; determining the tsunami hazard, including tsunami depth and velocity; different options for tsunami vertical evacuation structures; siting, spacing, sizing, and elevation considerations; determining tsunami and earthquake loads and related structural design criteria; and structural design concepts and other considerations. (Webinar course length: 90 minutes)

FEMA P-767 – Earthquake Mitigation for Hospitals

Students are introduced to earthquake hazards in health care settings and learn about methods that can be used to analyze and reduce risks of damage in hospitals and other medical buildings. Such facilities have unique nonstructural components, including equipment and infrastructure systems that can become sources of injury or damage even during smaller earthquakes.

By implementing sound, cost-effective mitigation measures, health care facilities can reduce or eliminate seismic risks and ensure that, in the event of an earthquake, they can remain in operation to serve their communities. (Course length: 1 day)

FEMA P-807 – *Seismic Evaluation and Retrofit of Multi-Unit Wood-Frame Buildings with Weak First Stories*

This training provides cost-effective retrofit procedures for structures that have weak ground floors, such as buildings that use ground floors to accommodate parking, storage, or other commercial uses. These structures are prevalent in the seismically active regions of the Pacific Northwest and California. The guidelines have been developed for ease of use, while providing a practicable and cost-effective means to reduce damage and the risk of collapse. The CD-ROM included with the publication includes a complete indexed PDF file of FEMA P-807 and the Weak Story Tool software. Target audiences include building owners and building officials, home inspectors, design professionals, home builders, emergency planners, insurers, and lenders. (Webinar course length: 90 minutes)

FEMA P-909 – *Home and Business Earthquake Safety and Mitigation*

This training program on structural and nonstructural earthquake mitigation has three components: a Train-the-Trainer course, a Home and Business Earthquake Safety and Mitigation course, and a Hands-On Interactive Mitigation Demonstration. The goal of the training is to create a cadre of trainers with the ability to provide basic knowledge on earthquakes; along with simple steps toward safety and mitigation in their homes and businesses. The training consists of PowerPoint slides, hands-on demonstration instructions, supply lists, scripts, quiz (and answers), certificates, and posters. Audiences include government at all levels, emergency managers, first responders, businesses, volunteer community groups, and all others interested in leading an earthquake safety presentation. (Course Length: 4 hours)

FEMA P-1019 – Emergency Power Systems for Critical Facilities

This training discusses the effects of natural hazards on electrical transmission and distribution infrastructure and on building systems. The course focuses on how to determine what facilities are critical, what equipment within a critical facility is needed to allow the facility to function and provide services, and how to provide emergency power to a critical facility. (Webinar course length: 90 minutes)

FEMA P-1024 – *Performance Assessment of Buildings and Nonstructural Components in the 2014 South Napa Earthquake*

Data from a USGS strong-motion recording instrument located in downtown Napa was used to investigate every building within a 1,000 foot radius using the ATC-38 methodology to compare their performance to the known

ground motion and document mitigation performance. This data was used to evaluate the performance of nonstructural components, responsible for the vast majority of the damage and injuries as well as help validate the new FEMA P-58 Seismic Performance Assessment of Buildings and FEMA P-154 RVS methodologies. (Course length: TBD)

FLOOD

Introduction to Coastal Foundation Design and Construction (FEMA P-550)

This course focuses on the guidance contained in FEMA P-550, Recommended Residential Construction for Coastal Areas, developed by FEMA. It discusses the unique loads foundations must resist in coastal and near coastal areas (flood, debris, breaking waves, etc.); addresses NFIP requirements; and discusses designing for high-wind events and for erosion and scour. The course describes the assumptions used in developing the FEMA P-550 foundation designs and how the designs can be customized by professionals to develop foundations for specific homes. This course is offered as a 1-day course geared to design professionals, and as a ½-day course geared to local officials.

If you are interested in this workshop please contact the FEMA Building Science Helpline by email at FEMA-Buildingsciencehelp@fema.dhs.gov or by phone at (866) 927-2104 (toll free).

Residential Coastal Construction (EMI 386)

FEMA designed this 4-day course to train participants on FEMA's *Coastal Construction Manual* (FEMA P-55), which is the primary, state-of-the-art reference for planning, designing, and constructing residential structures in various coastal environments. The target audience is engineers, architects, and building code officials. Floodplain management, hazard mitigation, planning, and building officials with building science knowledge may also apply. The course is taught at EMI. To register for the EMI course, all applications must be submitted through your State Emergency Management Training Office. A 2-day field course and an Independent Study Course are also available.

If you are interested in this workshop please contact the FEMA Building Science Helpline by email at FEMA-Buildingsciencehelp@fema.dhs.gov or by phone at (866) 927-2104 (toll free).

Local Officials Guide to Coastal Construction (FEMA P-762)

This 1-day course is designed to provide local officials with the information or reference to the information that they need to effectively conduct their duties in coastal communities. The course is based primarily on FEMA P-762, Local Official's Guide to Coastal Construction. The course will cover (1) design considerations; (2) regulations, codes, and standards; (3) permitting and inspections; (4) load paths, coastal foundations, and structural

systems; (5) and roof coverings and building envelopes, including windows, doors, and openings. The regulatory requirements that coastal officials must understand and enforce (including the connection between National Flood Insurance Program (NFIP) guidelines and applicable building codes and standards) and the permitting and inspection processes make this course essential for officials in coastal communities, but also best practices, accumulated from findings after recent hurricanes and coastal events, are shared with the students, so that course attendees may positively influence coastal construction with the lessons FEMA has gathered after recent storms. The course enhances the effectiveness of actions of coastal officials in their communities to make construction stronger and less vulnerable to coastal storms by focusing on helping officials reach a thorough understanding of issues unique to coastal environments.

If you are interested in this workshop please contact the FEMA Building Science Helpline by email at FEMA-Buildingsciencehelp@fema.dhs.gov or by phone at (866) 927-2104 (toll free).

Coastal Construction Workshop for Home Builders (FEMA P-499)

FEMA developed a series of 37 technical fact sheets that provide guidance and recommendations concerning the construction of coastal residential buildings. The fact sheets present information aimed at improving the performance of buildings subject to flood and wind forces in coastal environments. This introductory-level 3-hour training is made available to construction professionals in coastal areas to facilitate their understanding and use of these technical fact sheets and the design and construction practices they promote.

The goal of the workshop is to provide a practical learning experience that enables participants, upon completion of the workshop, to cite best practices that result in reduced damages to homes affected by coastal storms, locate information as needed in the *Home Builder's Guide to Coastal Construction* fact sheets, and implement building practices that will improve the performance of buildings subject to flood and wind forces in coastal environments.

If you are interested in this workshop please contact the FEMA Building Science Helpline by email at FEMA-Buildingsciencehelp@fema.dhs.gov or by phone at (866) 927-2104 (toll free).

Retrofitting Flood-Prone Residential Buildings (EMI 279)

FEMA developed a technical training course on proper methods of retrofitting residential buildings. This course is based on the content of FEMA P-259, *Engineering Principles and Practices of Retrofitting Floodprone Residential Structures*, Third Edition (2012). This course is designed to provide engineering and economic guidance to architects, engineers, and local code enforcement officials on retrofitting existing one- to four-family residential structures situated in flood-prone areas. The retrofitting measures presented are creative, practical, compliant with applicable floodplain regulations, and satisfactory to most homeowners. The course is available as a 4-day course offered at EMI. To register for the EMI course, all applications must be submitted through your State Emergency Management Training Office.

If you are interested in this workshop please contact the FEMA Building Science Helpline by email at FEMA-Buildingsciencehelp@fema.dhs.gov or by phone at (866) 927-2104 (toll free).

The Flood Provisions of the International Codes and ASCE 24

This 1-day workshop presents basic information needed to understand the flood provisions of the International Codes and ASCE 24, *Flood Resistant Design and Construction*, and the importance of coordinating local floodplain management ordinances with building codes. The 2009 and later editions of the I-Codes contain flood-resistant provisions that FEMA has determined to be consistent with the NFIP. Participants will learn how the I-Code provisions are consistent with the NFIP regulations; understand the relationship between the I-Codes and ASCE 24: learn about distinctions between the I-Codes and ASCE 24, and the NFIP regulations; and learn the importance of coordinating the I-Codes with local floodplain management ordinances. This course is also available as a half-day workshop focusing on the IRC.

If you are interested in this workshop please contact the FEMA Building Science Helpline by email at FEMA-Buildingsciencehelp@fema.dhs.gov or by phone at (866) 927-2104 (toll free).

Using FEMA Guidance to Administer the NFIP Substantial Improvement/Substantial Damage Requirements

This workshop will focus on using the Substantial Improvement/Substantial Damage Desk Reference (FEMA P-758) to administer the NFIP requirements in local floodplain management regulations and building codes. The workshop covers the basics of making Substantial Improvement/Substantial Damage determinations while illustrating how the Desk Reference is organized and the level of detail that it has on all aspects of the Substantial Improvement/Substantial Damage requirements. There are many factors that local officials need to consider and several scenarios they may encounter while administering the Substantial Improvement/Substantial Damage requirements, which are required by the International Codes. Emphasis is placed on all aspects of buildings that must be brought into compliance, which depend on flood zone and building occupancy. Some of the more common examples are discussed, including interior-only improvements, lateral and vertical additions, and historic structures. Following this workshop, the learner will understand and be able to effectively administer Substantial Improvement/Substantial Damage requirements. Learners already familiar with Substantial Improvement/Substantial Damage requirements will further their understanding of how administering Substantial Improvement/Substantial Damage responsibilities fits into the overall picture of floodplain management through day-to-day and post-disaster activities. The target audience for this workshop includes State and local floodplain managers, building officials, and plan reviewers.

If you are interested in this workshop please contact the FEMA Building Science Helpline by email at FEMA-Buildingsciencehelp@fema.dhs.gov or by phone at (866) 927-2104 (toll free).

FEMA P-784 Substantial Damage Estimator

The SDE Train-the-Trainer Course is a 2-day course designed to teach students about the SDE software and explain how the property-specific results are used to ensure compliance with the NFIP. It can also be used to secure Increased Cost of Compliance funding for property owners following flood events. The SDE software was developed to assist State and local officials in estimating both residential and non-residential building value and damage costs using FEMA-accepted approaches. The SDE software is based on the concept of using damage estimates for individual building elements to determine whether the structure as a whole is substantially damaged. This computer application was created to support enforcement of the NFIP's regulatory requirements and is intended to be used in conjunction with an industry-accepted construction cost-estimating guide.

Using the SDE-calculated building values, the user can apply a "Percent Damaged" or "Improved" value to establish a substantial damage/improvement determination for each structure. The SDE application is designed to accommodate residential and non-residential buildings such as, single-family residences, manufactured homes, schools, office buildings, police stations, hospitals, courthouses, department stores, grocery and convenience stores, and strip malls.

If you are interested in this workshop please contact the FEMA Building Science Helpline by email at FEMA-Buildingsciencehelp@fema.dhs.gov or by phone at (866) 927-2104 (toll free).

The SDE Substantial Damage Estimator (SDE) Independent Study Course

FEMA has developed a 3-hour Independent Study course on Substantial Damage estimating and use of the SDE Tool. The technical presentation will be designed for end users of the SDE Tool and will cover all aspects of the SDE, including field inspections and assessments, data collection and entry, evaluation and determination of the percent damage for each structure element, quality control, and data assessment, as well as use of the SDE results at the local level in new construction or repair processes.

If you are interested in this workshop please contact the FEMA Building Science Helpline by email at FEMA-Buildingsciencehelp@fema.dhs.gov or by phone at (866) 927-2104 (toll free).

HIGH WIND

Retrofitting Residential Buildings for Wind Hazards (FEMA P-804)

This ½ day course is to provide guidance on how to improve the wind resistance of existing residential buildings in the U.S. coastal regions where design wind speeds exceed 90 mph. This improved resistance can be achieved through the Basic, Intermediate, or Advanced "Mitigation Packag-

es," which offer incrementally resistant retrofit options for the homeowner. This course teaches how to select and implement effective wind retrofit projects for one- and two family dwellings. It does not apply to manufactured housing. This course follows the content of FEMA P-804, *Wind Retrofit Guide for Residential Buildings*.

There are multiple intended audiences for this course. Homeowners should be involved in the process of the wind retrofit project; they must understand who must understand the benefits and costs of each potential decisions. In turn, homeowners will work with their evaluator, design professional (if necessary), and contractor to determine which wind retrofit project is most appropriate. State and local governments and entities that have mitigation programs in hurricane-prone regions will also benefit from this course by using the information to deliver technical assistance to the public.

If you are interested in this workshop please contact the FEMA Building Science Helpline by email at FEMA-Buildingsciencehelp@fema.dhs.gov or by phone at (866) 927-2104 (toll free).

Design and Construction Guidance for Safe Rooms (FEMA P-361/P-320)

This course is available as a 2-day and 1-day training course, discussing design and construction of community and residential safe rooms. The target audience is architects, engineers, and emergency managers. The course uses as its base text the two popular publications FEMA P-361 and FEMA P-320. The training discusses how both hazard identification, and design and construction criteria (specific to tornado, hurricane, and combined hazards) have changed over the years. In addition, how the FEMA publications are in alignment with the minimum requirements of the International Code Council/National Storm Shelter Association (ICC/NSSA) 500 Standard for the Design and Construction of Storm Shelters (ICC 500) is discussed. Specific guidance and design criteria for operational or emergency management issues, which are not addressed in the ICC 500, are also described. The presentation also covers the elements of wind and flood design criteria in FEMA P-361 that differ from those of the ICC 500 standard. The latter is important because FEMA P-361 is the basis of the technical design criteria used for FEMA grant programs that fund the design and construction of hurricane and tornado safe rooms.

If you are interested in this workshop please contact the FEMA Safe Room Helpline by email at SafeRoom@fema.dhs.gov or by phone at (866) 927-2104 (toll free).

Building a Safe Room for Your Home or Small Business (FEMA P-320)

This ½-day training course provides construction guidance for residential and small business safe rooms. The target audience is builders, contractors, and interested safe room consumers. The course uses as its base text the popular publication FEMA P-320, and discusses the natural hazards that affect

safe rooms, how to use the FEMA P-320 design drawings, and the unique aspects of safe room design.

If you are interested in this workshop please contact the FEMA Safe Room Helpline by email at SafeRoom@fema.dhs.gov or by phone at (866) 927-2104 (toll free).

Evaluating Buildings to Identify Best Available Refuge Areas

This 1-day training course focuses on the evaluation of proposed building areas for use as Best Available Refuge Areas for protection from tornadoes. The target audience is architects, engineers, school officials, and emergency managers. The course provides background on tornado safe room design and construction issues found in FEMA P-361, then presents information that will aid qualified architects and engineers in the identification of the best available refuge areas, as discussed in FEMA P-431, *Tornado Protection: Selecting Refuge Areas in Buildings*. After examining design considerations and beneficial characteristics of candidate refuge areas, participants review example construction drawings and site photos to rank building areas using the Best Available Refuge Area Checklist.

If you are interested in this workshop please contact the FEMA Safe Room Helpline by email at SafeRoom@fema.dhs.gov or by phone at (866) 927-2104 (toll free).

MULTI-HAZARD

FEMA Best Practices for Flood and Wind Mitigation

This is offered as either a ½-day or 1-day course. It discusses wind and flood mitigation techniques that equal or exceed I-Code requirements for both riverine and coastal areas. The course provides information on improving hazard resistance for retrofitting projects and new construction of residential buildings. It consolidates information from recently updated FEMA guidance publications, including: Coastal Construction Manual (FEMA P-55, 2011), Engineering Principals and Practices for Retrofitting Flood-Prone Residential Structures (FEMA P-259, 2012), Wind Retrofit Guide (FEMA P-804, 2010), and the Flood Resistant Design CodeMaster (S.K. Ghosh & Associates, 2011). The target audience is administrators, architects, code officials, contractors/builders, engineers, inspectors, and plan examiners.

If you are interested in this workshop please contact the FEMA Building Science Helpline by email at FEMA-Buildingsciencehelp@fema.dhs.gov or by phone at (866) 927-2104 (toll free).

Fundamentals of Building Science (EMI 312)

This 4-day course is designed to introduce potential natural hazard impacts on the performance of the constructed environment. The target audience is Federal, State, and local emergency response staff; local building officials; and

other building professionals responsible for the design and/or operation of buildings or other infrastructure facilities. Hazards discussed include floods, winds, earthquakes, and wildfires. The behavior of each hazard is reviewed, followed by a discussion of their potential impacts on or threats to buildings and infrastructure. The threats are evaluated qualitatively and quantitatively. The introduction to each hazard is followed by a discussion of mitigation strategies and techniques proven to be effective in mitigating the effects of that hazard. After discussions of the individual hazards are complete, the mitigation measures are represented for further evaluation relative to hazards other than the specific hazard for which it was originally intended. The focus is to not only identify mitigation strategies that may reduce the risks from more than one hazard, but also to consider the potential unintended increased risks from another hazard. The course is available as a 4-day course offered at EMI. To register for the EMI course, all applications must be submitted through your State Emergency Management Training Office.

Three videos based on webinars abridged from this training course are available on the FEMA P-940 CD, *Multi-Hazard Mitigation and Design Concepts: Wind, Flood, and Earthquake Training Videos*, available online at https://www.fema.gov/media-library/assets/documents/95935.

If you are interested in this workshop please contact the FEMA Building Science Helpline by email at FEMA-Buildingsciencehelp@fema.dhs.gov or by phone at (866) 927-2104 (toll free).

Design Guide for Improving Critical Facility Safety from Flooding and High Winds: Providing Protection to People and Buildings (FEMA 543)

This 2-day course on FEMA 543 was developed to help improve the design, construction, reconstruction, and rehabilitation of critical facilities in areas exposed to flooding and high winds. The target audience is architects and engineers with existing knowledge of building science.

The performance of critical facilities (e.g., hospitals, fire and police stations, schools, and emergency operations centers) during recent natural disasters has been impaired by storm-related damages, as documented by post-disaster reports. Critical facilities provide critical life-safety services to citizens of affected areas. The course is intended to enable participants to support and implement design techniques and construction practices that will improve building performance and result in critical facilities remaining fully operational during and after flooding and high-wind events.

If you are interested in this workshop please contact the FEMA Building Science Helpline by email at FEMA-Buildingsciencehelp@fema.dhs.gov or by phone at (866) 927-2104 (toll free).

Table 1. List of Publications in this Catalog

ONLINE CD PRINT

PUBLICATION NO.	TITLE	PAGE NO.	EARTHQUAKE	FLOOD	HIGH WIND	FIRE OR SNOW	FORMAT
Numbered Publications							
FIA 22	*Hurricane Andrew in Florida: Observations, Recommendations, and Technical Guidance*	79			■		
FIA 23	*Hurricane Iniki in Hawaii: Observations, Recommendations, and Technical Guidance*	78		■	■		
IS-22	*Are You Ready? An In-Depth Guide to Citizen Preparedness*	82	■	■	■	■	
FEMA P-50	*Simplified Seismic Assessment of Detached, Single-Family, Wood-Frame Dwellings*	4, 11, 16, 19	■				
FEMA P-50-1	*Seismic Retrofit Guidelines for Detached, Single-Family, Wood-Frame Dwellings*	4, 11, 16, 19	■				
FEMA P-55	*Coastal Construction Manual (Fourth Edition)*	59		■	■		
FEMA P-58-1	*Seismic Performance Assessment of Buildings-Volume 1*	32	■				
FEMA P-58-2	*Seismic Performance Assessment of Buildings-Volume 2*	33	■				
FEMA P-58CD	*Seismic Performance Assessment of Buildings-Supporting Materials*	33	■				
FEMA E-74CD	*Reducing the Risks of Nonstructural Earthquake Damage-A Practical Guide*	3, 9, 28	■				

PUBLICATION NO.	TITLE	PAGE NO.	EARTHQUAKE	FLOOD	HIGH WIND	FIRE OR SNOW	FORMAT
FEMA 83	*Seismic Considerations for Communities at Risk*	14	■				
FEMA P-85	*Protecting Manufactured Homes from Floods and Other Hazards (Second Edition)*	42		■	■		
FEMA P-154	*Rapid Visual Screening of Buildings for Potential Seismic Hazards-A Handbook*	18	■				
FEMA P-154 ROVER CD	*Rapid Observation of Vulnerability and Estimation of Risk, Version 2*	18	■				
FEMA 155	*Rapid Visual Screening of Buildings for Potential Seismic Hazards-Supporting Documentation*	18	■				
FEMA 156	*Typical Costs for the Seismic Rehabilitation of Existing Buildings-Volume 1*	23	■				
FEMA 157	*Typical Costs for the Seismic Rehabilitation of Existing Buildings-Volume 2*	23	■				
FEMA 159	*Tremor Troops: Earthquakes-A Teacher's Package for K-6*	7	■				
FEMA 182	*Landslide Loss Reduction: A Guide for State and Local Government Planning*	15	■				
FEMA 198	*Financial Incentives for the Seismic Rehabilitation of Hazardous Buildings: Volume 1*	14	■				
FEMA199	*Financial Incentives for the Seismic Rehabilitation of Hazardous Buildings: Volume 2*	15	■				
FEMA 202	*Earthquake Resistant Construction of Electric Transmission and Telecommunication Facilities Serving the Federal Government*	32	■				

PUBLICATION NO.	TITLE	PAGE NO.	EARTHQUAKE	FLOOD	HIGH WIND	FIRE OR SNOW	FORMAT
FEMA 221	*Collocation Impacts on the Vulnerability of Lifelines during Earthquakes with Application to the Cajon Pass, California: Study Overview*	31	■				
FEMA 224	*Seismic Vulnerability and Impact of Disruption of Lifelines in the Conterminous United States*	32	■				
FEMA 225	*Inventory of Lifelines in the Cajon Pass, California*	31	■				
FEMA 226	*Collocation Impacts on the Vulnerability of Lifelines during Earthquakes with Application to the Cajon Pass, California: Study Overview*	31	■				
FEMA 232 and P-232CD	*Homebuilders' Guide to Earthquake Resistant Design and Construction*	4, 16	■				
FEMA 233	*Earthquake Resistant Construction of Gas and Liquid Fuel Pipeline Systems Serving or Regulated by the Federal Government*	30	■				
FEMA 253	*Seismic Sleuths: Earthquakes-A Teacher's Package for Grades 7-12*	7	■				
FEMA 255	*Seismic Rehabilitation of Federal Buildings: A Benefit/Cost Model-Volume 1*	24	■				
FEMA 256	*Seismic Rehabilitation of Federal Buildings: A Benefit/Cost Model-Volume 2*	24	■				
FEMA P-259	*Engineering Principles and Practices for Retrofitting Flood-Prone Residential Structures (Third Edition)*	58		■			
FEMA 266	*Creating a Seismic Risk Advisory Board: A Guide to Earthquake Risk Management*	14	■				
FEMA 275	*Planning for Seismic Rehabilitation: Societal Issues*	13	■				

PUBLICATION NO.	TITLE	PAGE NO.	EARTHQUAKE	FLOOD	HIGH WIND	FIRE OR SNOW	FORMAT
FEMA 277	*The Oklahoma City Bombing: Improving Building Performance Through Multi-Hazard Mitigation*	89					
FEMA 281	*Hurricane Opal in Florida*	78		■			
FEMA 290	*Hurricane Fran in North Carolina: Building Performance Observations, Recommendations, and Technical Guidance*	78		■	■		
FEMA 306 and P-306/307/ 308 CD	*Evaluation of Earthquake Damaged Concrete and Masonry Wall Buildings: Basic Procedures Manual*	37	■				
FEMA 307	*Evaluation of Earthquake Damaged Concrete and Masonry Wall Buildings: Technical Resources*	37	■				
FEMA 308	*Evaluation of Earthquake Damaged Concrete and Masonry Wall Buildings*	37	■				
FEMA P-312	*Homeowner's Guide to Retrofitting (Third Edition)*	41		■			
FEMA 313	*Promoting the Adoption and Enforcement of Seismic Buildings Codes: A Guidebook for State Earthquake and Mitigation Managers*	13	■				
FEMA P-320	*Taking Shelter from the Storm: Building a Safe Room for Your Home or Small Business (Fourth Edition)*	65, 70			■		
FEMA 338	*Hurricane Georges in the Gulf Coast: Building Performance Observations, Recommendations, and Technical Guidance*	77		■	■		
FEMA 339	*Hurricane Georges in Puerto Rico: Building Performance Observations, Recommendations, and Technical Guidance*	77		■	■		
FEMA 342	*Midwest Tornadoes of May 3, 1999: Observations, Recommendations, and Technical Guidance*	77			■		
FEMA 347	*Above the Flood: Elevating Your Floodprone House*	42		■			

PUBLICATION NO.	TITLE	PAGE NO.	EARTHQUAKE	FLOOD	HIGH WIND	FIRE OR SNOW	FORMAT
FEMA P-348	*Protecting Building Utilities From Flood Damage: Principles and Practices for the Design and Construction of Flood Resistant Building Utility Systems*	44, 60		■			
FEMA 349	*Action Plan for Performance Based Seismic Design*	35	■				
FEMA 350	*Recommended Seismic Design Criteria for New Steel-Moment Frame Buildings*	36	■				
FEMA 351	*Recommended Seismic Evaluation and Upgrade Criteria for Existing Welded Steel-Moment Frame Buildings*	36	■				
FEMA 352	*Recommended Postearthquake Evaluation and Repair Criteria for Existing Welded Steel-Moment Frame Buildings*	36	■				
FEMA 353	*Recommended Specifications and Quality Assurance Guidelines for Steel-Moment Frame Construction for Seismic Applications*	37	■				
FEMA 354	*A Policy Guide to Steel-Moment Frame Construction*	35	■				
FEMA 355 CD	*Seismic Design Criteria for Steel-Moment Frame Structures*	35	■				
FEMA 356	*Prestandard and Commentary fort the Seismic Rehabilitation of Buildings*	23	■				
FEMA P-361	*Safe Rooms for Tornadoes and Hurricanes: Guidance for Community and Residential Safe Rooms (Third Edition)*	64, 66, 69			■		
FEMA 366	*HAZUS-MH Estimated Annualized Earthquake Losses for the United States*	12	■				
FEMA 388 CD	*Safe Room Resources CD*	67			■		

PUBLICATION NO.	TITLE	PAGE NO.	EARTHQUAKE	FLOOD	HIGH WIND	FIRE OR SNOW	FORMAT
FEMA 389	*Communicating with Owners and Managers of New Buildings on Earthquake Risk*	28	■				
FEMA 395	*Incremental Seismic Rehabilitation of School Buildings (K-12)*	21	■				
FEMA 396	*Incremental Seismic Rehabilitation of Hospital Buildings*	21	■				
FEMA 397	*Incremental Seismic Rehabilitation of Office Buildings*	22	■				
FEMA 398	*Incremental Seismic Rehabilitation of Multifamily Apartment Buildings*	22	■				
FEMA 399	*Incremental Seismic Rehabilitation of Retail Buildings*	22	■				
FEMA 400	*Incremental Seismic Rehabilitation of Hotel/ Motel Buildings*	22	■				
FEMA 403	*World Trade Center Building Performance Study: Data Collection, Preliminary Observations, and Recommendations*	89					
FEMA 412	*Installing Seismic Restraints for Mechanical Equipment*	30	■				
FEMA 413	*Installing Seismic Restraints for Electrical Equipment*	30	■				
FEMA 414	*Installing Seismic Restraints for Duct and Pipe*	30	■				
FEMA P-420	*Engineering Guidelines for Incremental Seismic Rehabilitation*	22	■				
FEMA P-424	*Design Guide for School Safety in Earthquakes, Floods, and High Winds*	87	■	■	■		

PUBLICATION NO.	TITLE	PAGE NO.	EARTHQUAKE	FLOOD	HIGH WIND	FIRE OR SNOW	FORMAT
FEMA P-431	*Tornado Protection: Selecting Refuge Areas in Buildings (Second Edition)*	69			■		
FEMA 439A CD	*Blast Resistance Benefits of Seismic Design: Phase 1 Study*	39	■				
FEMA 439	*Blast Resistance Benefits of Seismic Design: Phase 2 Study*	38	■				
FEMA 440 and 440 CD	*Improvement of Nonlinear Static Seismic Analysis Procedures*	34	■				
FEMA P-440A	*Effects of Strength and Stiffness Degradation on Seismic Response*	33	■				
FEMA 445	*Next-Generation Performance-Based Seismic Design Guidelines: Program Plan for New and Existing Buildings*	34	■				
FEMA 450 and 450 CD	*NEHRP Recommended Provisions and Commentary for Seismic Regulations for New Buildings and Other Structures*	28	■				
FEMA 454 CD	*Designing for Earthquakes: A Manual for Architects*	27	■				
FEMA 460	*Seismic Considerations for Steel Storage Racks Located in Areas Accessible to the Public*	29	■				
FEMA 461	*Interim Testing Protocols for Determining the Seismic Performance Characteristics of Structural and Nonstructural Components*	33	■				
FEMA 474	*Promoting Seismic Safety: Guidance for Advocates*	13	■				
FEMA 488	*Hurricane Charley in Florida: Observations, Recommendations, and Technical Guidance*	76		■	■		

PUBLICATION NO.	TITLE	PAGE NO.	EARTHQUAKE	FLOOD	HIGH WIND	FIRE OR SNOW	FORMAT
FEMA 489	*Hurricane Ivan in Alabama and Florida: Observations, Recommendations, and Technical Guidance*	75		■	■		
FEMA 490	*Summary Report on Building Performance 2004 Hurricane Season*	76		■	■		
FEMA 497	*National Flood Mitigation Data Collection Tool and RLP Viewer - User's Guide (FEMA 497)*	49		■			
FEMA P-499	*Home Builder's Guide to Coastal Construction, Technical Fact Sheet Series (37 Fact Sheets)*	59		■	■		
FEMA B-526	*Earthquake Safety Checklist*	3, 5	■				
FEMA 527	*Earthquake Safety Activities for Children and Teachers*	6, 8	■				
FEMA V-528	*Earthquake Home Hazard Hunt Poster*	3	■				
FEMA 529	*Drop, Cover and Hold On Poster*	7	■				
FEMA 530	*Earthquake Safety Guide for Homeowners*	5	■				
FEMA 531	*The Adventures of Terry the Turtle and Gracie the Wonder Dog, Grades 3-6*	6	■				
FEMA 543	*Design Guide for Improving Critical Facility Safety from Flooding and High Winds*	87		■	■		
FEMA 547 and 547 CD	*Techniques for the Seismic Rehabilitation of Existing Buildings*	21	■				
FEMA 548	*Summary Report on Building Performance: Hurricane Katrina 2005*	75		■	■		

PUBLICATION NO.	TITLE	PAGE NO.	EARTHQUAKE	FLOOD	HIGH WIND	FIRE OR SNOW	FORMAT
FEMA 549	*Hurricane Katrina in the Gulf Coast: Building Performance Observations, Recommendations, and Technical Guidance*	74		■	■		
FEMA P-550	*Recommended Residential Construction in Coastal Areas: Building on Strong and Safe Foundations (Second Edition)*	60		■	■		
FEMA 551	*Selecting Appropriate Mitigation Measures for Floodprone Structures*	48		■			
FEMA 577	*Design Guide for Improving Hospital Safety in Earthquakes, Floods, and High Winds*	87	■	■	■		
FEMA P-593 CD	*Seismic Rehabilitation Training for One- and Two-Family Dwellings: Program and Slide Presentations*	16, 20	■				
FEMA P-646	*Guidelines for Design of Structures for the Vertical Evacuation from Tsunamis*	38	■				
FEMA P-646A	*Vertical Evacuation from Tsunamis: A Guide for Community Officials*	12	■				
FEMA P-695 and P-695 CD	*Quantification of Building Seismic Performance Factors*	27	■				
FEMA P-710 CD	*Earthquake Publications for Teachers and Kids*	6	■				
FEMA P-711 CD	*Earthquake Publications for Individuals and Homeowners*	4	■				
FEMA P-712 CD	*Earthquake Publications for Community Planners and Public Policy Makers*	12	■				
FEMA P-737	*Home Builder's Guide to Construction in Wildfire Zones Technical Fact Sheet Series (17 Fact Sheets)*	91				■	
FEMA P-749	*Earthquake Resistant Design Concepts: An Introduction to the NEHRP Seismic Provisions*	11, 26	■				

PUBLICATION NO.	TITLE	PAGE NO.	EARTHQUAKE	FLOOD	HIGH WIND	FIRE OR SNOW	FORMAT
FEMA P-750 and P-750 CD	*NEHRP Recommended Seismic Provisions for New Buildings and Other Structures: 2009 Edition*	26	■				
FEMA P-751 CD	*2009 NEHRP Recommended Seismic Provisions: Design Examples*	25	■				
FEMA P-752 CD	*NEHRP Recommended Seismic Provisions: for New Buildings and Other Structures: Training and Instructional Materials*	25	■				
FEMA P-753 DVD	*2009 NEHRP Recommended Seismic Provisions: for New Buildings and Other Structures: A Compendium*	25	■				
FEMA P-754	*Wildfire Hazard Mitigation Handbook for Public Facilities*	91				■	
FEMA P-757	*Hurricane Ike in Texas and Louisiana: Building Performance Observations, Recommendations, and Technical Guidance*	74		■	■		
FEMA P-758	*Substantial Improvement/ Substantial Damage Desk Reference*	47		■			
FEMA P-762	*Local Officials Guide for Coastal Construction*	47		■	■		
FEMA P-765	*Midwest Floods of 2008 in Iowa and Wisconsin: Building Performance Observations, Recommendations, and Technical Guidance*	61		■			
FEMA P-767 CD	*Earthquake Mitigation for Hospitals*	20	■				
FEMA P-774 and P-774 CD	*Unreinforced Masonry Buildings and Earthquakes: Developing Successful Risk Reduction Programs*	12, 20	■				
FEMA P-784	*The FEMA Substantial Damage Estimator (SDE) (Version 2.0 September 2011)*	48		■			
FEMA P-795 and P-795 CD	*Quantification of Building Seismic Performance Factors: Component Equivalency Methodology*	26	■				

PUBLICATION NO.	TITLE	PAGE NO.	EARTHQUAKE	FLOOD	HIGH WIND	FIRE OR SNOW	FORMAT
FEMA B-797	*Hazard Mitigation Field Book: Roadways*	47		■			
FEMA P-798	*Natural Hazards and Sustainability for Residential Buildings*	84		■	■		
FEMA P-804	*Wind Retrofit Guide for Residential Buildings*	63, 69			■		
FEMA P-807	*Seismic Evaluation and Retrofit of Multi-Unit Wood-Frame Buildings with Weak First Stories*	19	■				
FEMA P-811 DVD	*Earthquake Publications for Businesses: QuakeSmart Toolkit*	10	■				
FEMA P-905	*Mitigation Assessment Team and Building Performance Assessment Team Reports*	71		■	■		
FEMA P-907	*Risk Management Series: Multi-Hazard*	86	■	■	■		
FEMA P-908	*Spring Tornadoes: April 25-28 and May 22*	73			■		
FEMA P-909 CD	*Home and Business Earthquake Safety and Mitigation*	9	■				
FEMA P-936	*Floodproofing Non-Residential Buildings*	43, 58		■			
FEMA P-938	*Hurricane Isaac in Louisiana: Building Performance Observations, Recommendations, and Technical Guidance*	72		■	■		
FEMA P-940 CD	*Multi-Hazard Mitigation and Design Concepts: Wind, Flood, and Earthquake Training Videos*	81	■	■	■		
FEMA P-942	*Hurricane Sandy in New Jersey and New York: Building Performance Observations, Recommendations, and Technical Guidance*	71		■	■		

PUBLICATION NO.	TITLE	PAGE NO.	EARTHQUAKE	FLOOD	HIGH WIND	FIRE OR SNOW	FORMAT
FEMA P-950 CD	*FEMA Building Science Toolkit CD*	45, 84	■	■	■	■	
FEMA P-957	*Snow Load Safety Guide*	90				■	
FEMA P-1019	*Emergency Power Systems for Critical Facilities: A Best Practices Approach to Improving Reliability*	86	■	■	■		
FEMA P-1020	*Formal Observation Report- Oklahoma, May 20, 2013Safe Room Performance, Observations, and Conclusions*	71			■		
FEMA P-1024	*Performance Assessment of Buildings and Nonstructural Components in the 2014 South Napa Earthquake*	17	■				
FEMA P-1026	*Seismic Design of Rigid Wall-Flexible Diaphragm Buildings An Alternate Design Procedure*	17	■				
FEMA P-1050	*2015 NEHRP Recommended Seismic Provisions for New Buildings and Other Structures*	24	■				
FEMA P-1051 CD	*2015 NEHRP Recommended Seismic Provisions for New Buildings and Other Structures: Design Examples*	24	■				
FEMA P-1052 CD	*2015 NEHRP Recommended Seismic Provisions for New Buildings and Other Structures: Training and Instructional Materials*	24	■				
Recovery Advisories							
	Hurricane Charley Recovery Advisories (2004)	76			■		
	Hurricane Ivan Recovery Advisories (2004)	76		■	■		
	Hurricane Katrina Recovery Advisories (2005)	75		■	■		

PUBLICATION NO.	TITLE	PAGE NO.	EARTHQUAKE	FLOOD	HIGH WIND	FIRE OR SNOW	FORMAT
	Hurricane Ike Recovery Advisories (2008)	74		■	■		
	2008 Midwest Floods Recovery Advisories	61		■			
	2011 Tornado Recovery Advisories in Alabama, Georgia, Mississippi, Tennessee, and Missouri	73			■		
	Hurricane Isaac Recovery Advisories (2012)	73		■	■		
	Hurricane Sandy Recovery Advisories (2013)	72		■	■		
Technical Bulletins							
FEMA TB-0	*User's Guide to NFIP Technical Bulletins*	43, 55		■			
FEMA TB-1	*Openings in Foundation Walls and Walls of Enclosures*	55		■			
FEMA TB-2	*Flood Damage-Resistant Materials Requirements*	56		■			
FIA TB-3	*Non-Residential Floodproofing – Requirements and Certification*	56		■			
FEMA TB-4	*Elevator Installation*	56		■			
FEMA TB-5	*Free-of-Obstruction Requirements*	56		■			
FIA TB-6	*Below-Grade Parking Requirements*	56		■			
FIA TB-7	*Wet Floodproofing Requirements*	57		■			

PUBLICATION NO.	TITLE	PAGE NO.	EARTHQUAKE	FLOOD	HIGH WIND	FIRE OR SNOW	FORMAT
FIA TB-8	*Corrosion Protection for Metal Connectors in Coastal Areas*	57		■			
FEMA TB-9	*Design and Construction Guidance for Breakaway Walls Below Elevated Coastal Buildings*	57		■			
FIA TB-10	*Ensuring That Structures Built on Fill In or Near Special Flood Hazard Areas Are Reasonably Safe From Flooding*	57		■			
FIA TB-11	*Crawlspace Construction for Buildings Located in Special Flood Hazard Areas*	57		■			
Brochure							
FEMA L-233	*Taking Shelter from the Storm: Building a Safe Room for Your Home or Small Business*	65			■		
FEMA L-780	*Building Science for Disaster-Resistant Communities: Wind Hazard Publications*	67			■		
FEMA L-781	*Building Science for Disaster-Resistant Communities: Hurricane Hazard Publications*	68		■	■		
FEMA L-782	*Building Science for Disaster-Resistant Communities: Flood Hazard Publications*	47		■			
Protect Your Property or Business From Disaster Series							
	Protect Your Business From All Natural Hazards	83	■	■	■	■	
	Protect Your Property From Flooding	41, 43		■			
	Protect Your Property From High Winds	63, 66			■		
	Protect Your Property from Fire	92				■	
Fact Sheets and Flyers							
	ABCs of Returning to Flooded Buildings	41		■			
	Community Safe Room Fact Sheet	67			■		
	FEMA Snow Load Safety Guidance Fact Sheet	90				■	

PUBLICATION NO.	TITLE	PAGE NO.	EARTHQUAKE	FLOOD	HIGH WIND	FIRE OR SNOW	FORMAT
	Flood Hazard Elevation and Siting Criteria for Community Safe Rooms	70		■	■		
	Flood Hazard Elevation and Siting Criteria for Residential Safe Rooms	64, 70		■	■		
	Hurricane Sandy Fact Sheet 1, Cleaning Flooded Buildings	72		■			
	Hurricane Sandy Fact Sheet 2, Foundation Requirements and Recommendations for Elevated Homes	72		■			
	Hurricane Sandy Fact Sheet 3, Building Science Support and Code Changes Aiding Sandy Recovery	72		■	■		
	Hurricane Sandy Issue Paper - Guidance for Turning the Power Back On	41		■	■		
	Residential Safe Room Fact Sheet	64			■		
	Residential Tornado Safe Room Doors Fact Sheet	65			■		
	Rebuilding After a Wildfire Fact Sheet	91				■	
Other							
	Best Practices for Incorporating Building Science Guidance into Community Risk MAP Implementation	46		■			
	Building Codes Toolkit	81	■	■	■	■	
	CodeMaster for Flood Resistant Design (2011)	54		■			
	Evaluation of NFIP Program's Building Standards (October 2006) and Supplement (2008)	55		■			
	Flood Hazard Mitigation Handbook for Public Facilities	48		■			
	Flood Provisions of the International Code Series: Higher Standards	52		■			
	Flood Resistant Provisions of the 2015 International Codes	51		■			

PUBLICATION NO.	TITLE	PAGE NO.	EARTHQUAKE	FLOOD	HIGH WIND	FIRE OR SNOW	FORMAT
	Flood Resistant Provisions of the 2012 International Codes	53		■			
	Flood Resistant Provisions of the 2012 Uniform Codes by the International Association of Plumbing and Mechanical Officers (IAPMO)	53		■			
	Flood Resistant Provisions of the 2009 International Codes	54		■			
	Guidance for Applying ASCE 24 Engineering Standards to HMA Flood Retrofitting and Reconstruction Projects	45, 51		■			
	Highlights of ASCE 24, Flood Resistant Design and Construction	50		■			
	Hurricane Mitigation: A Handbook for Public Facilities	68		■	■		
	Including Building Codes in the National Flood Insurance Program	52		■			
	NFIP 2012 I-Codes and ASCE 24 Checklist	52		■			
	NFIP 2009 I-Codes and ASCE 24 Checklist	52		■			
	Provisions of the 2009 I-Codes and ASCE 24 Compared to the NFIP	54		■			
	Quick Reference Guide: Comparison of Select NFIP and Building Code Requirements for Special Flood Hazard Areas	53		■			
	Recommended Procedures for Flood Velocity Development	46		■			
	Reducing Flood Losses Through the International Codes (Fourth Edition)	50		■			

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FEMA P-787
Catalog No: 10076-1